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AUSTROBAILEYA

A Journal of Plant Systematics

Queensland Herbarium

Queensland Government
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Volume 7 Number 3 2007

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A taxonomic revision of *Ricinocarpos* Desf. (Euphorbiaceae: *Ricinocarpeae*, *Ricinocarpinae*)

David A. Halford and Rodney J.F. Henderson

Summary

Halford, D.A. & Henderson, R.J.F. (2007). A taxonomic revision of *Ricinocarpos* Desf. (Euphorbiaceae: *Ricinocarpeae*, *Ricinocarpinae*). *Austrobaileya* 7(3): 387–449. The genus *Ricinocarpos* Desf. is endemic to Australia. Twenty-eight species are recognised as belonging to it, and a key is provided for their identification. The following species are described here as new: *R. brevis* R.J.F.Hend. & Mollemans, *R. caniana* Halford & R.J.F.Hend., *R. crispatus* Halford & R.J.F.Hend., *R. graniticus* Halford & R.J.F.Hend., *R. linearifolius* Halford & R.J.F.Hend., *R. megalocarpus* Halford & R.J.F.Hend., *R. oliganthus* Halford & R.J.F.Hend., *R. pilifer* Halford & R.J.F.Hend., *R. ruminatus* Halford & R.J.F.Hend., *R. trachyphyllus* Halford & R.J.F.Hend., *R. trichophyllus* Halford & R.J.F.Hend. and *R. verrucosus* Halford & R.J.F.Hend. The new species are illustrated and distinguished from similar species while all taxa are described and mapped, and notes on their habitat, distribution and phenology are given. Lectotypes are chosen for *R. ledifolius* F.Muell., *R. marginatus* Benth., *R. muricatus* Müll.Arg., *R. pinifolius* Desf., *R. rosmarinifolius* Benth., *R. stylosus* Diels and *R. velutinus* F.Muell. *Ricinocarpos glaucus* var. *jasminoides* Baill. is neotypified. All known synonyms are listed here including phrase names that were used to identify taxa prior to their formal naming in this publication.

Key Words: Euphorbiaceae, *Ricinocarpos*, *Ricinocarpos brevis*, *Ricinocarpos caniana*, *Ricinocarpos crispatus*, *Ricinocarpos graniticus*, *Ricinocarpos linearifolius*, *Ricinocarpos megalocarpus*, *Ricinocarpos oliganthus*, *Ricinocarpos pilifer*, *Ricinocarpos ruminatus*, *Ricinocarpos trachyphyllus*, *Ricinocarpos trichophyllus*, *Ricinocarpos verrucosus*, Australia, Australian flora, taxonomy, nomenclature, identification keys

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Introduction

Ricinocarpos Desf. is endemic to Australia with twenty-eight species recognised in the present revision. All species are woody, perennial shrubs or rarely small trees and the majority (twenty-six species) grow in shrubland, heathland or dry sclerophyll open forest or woodland communities, generally in sandy soils. One species (*R. speciosus* Müll.Arg.) occurs in wet sclerophyll forest communities, while another species (*R. ledifolius* F.Muell.) grows in vine thicket or vine forest communities.

The genus was established by Desfontaines in 1817 to include a single species, *R. pinifolius*, based on material collected by botanists in 1802 at Port Jackson, New South Wales, during the visit of the Baudin Expedition (Desfontaines 1817). Desfontaines coined the name for his new genus from the generic name *Ricinus* L. (from Latin '*ricinus*', a tick, in reference to the appearance of the seeds of that genus) and Greek '*karpos*', fruit, because of the resemblance of its fruits to those in the genus *Ricinus*.

At the time, Desfontaines considered *Ricinocarpos* allied to *Jatropha* L. but differing from that genus by having a 5-petalled corolla, a staminal column bearing anthers from the base to the apex, echinate fruit and a different overall habit. Since the 1860s, *Ricinocarpos* has been consistently linked to *Beyeria* Miq. within the Euphorbiaceae (Müller 1865, 1866; Baillon 1874; Bentham 1880; Grüning 1913). In the most recent taxonomic placement, Webster (1994) included *Ricinocarpos* in Euphorbiaceae subfamily *Crotonoideae* Pax, tribe *Ricinocarpeae* Müll.Arg., subtribe *Ricinocarpinae* Webster, together with *Beyeria* and *Alphandia* Baill. Molecular studies of

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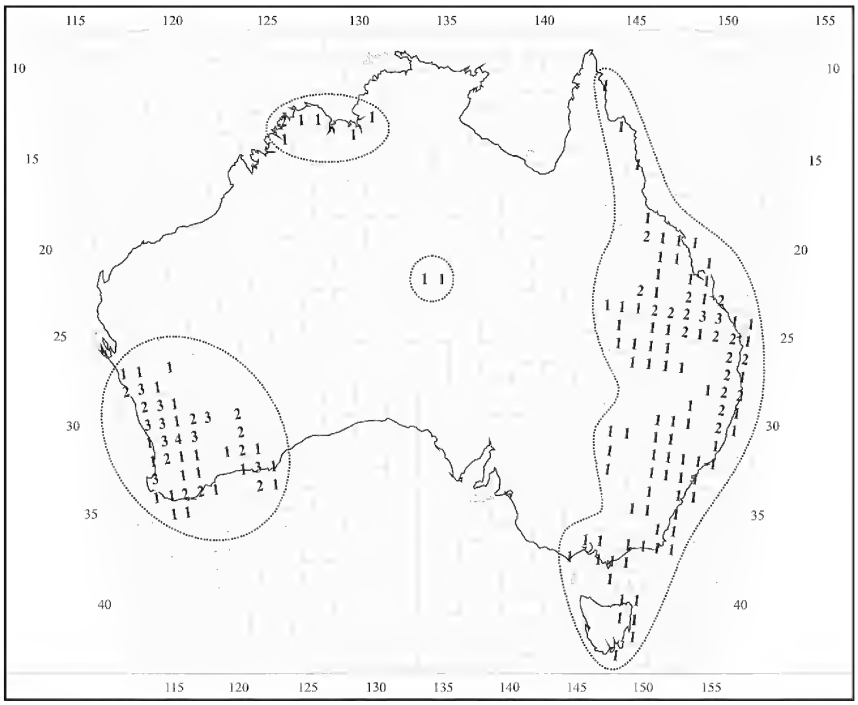
the uniovulate Euphorbiaceae (Wurdack *et al.* 2005) strongly supported the close relationship of *Ricinocarpos* and *Beyeria* as well as with another endemic Australian genus *Bertya* Planch. Halford and Henderson (2005) established the genus *Shonia* R.J.F.Hend. & Halford to accommodate *Beyeria tristigma* and its allies which are closely related to *Ricinocarpos*. *Ricinocarpos* is distinguished from *Beyeria*, *Shonia* and *Bertya* by the following combination of features: flowers in umbelliform clusters or racemes or solitary, petals mostly present in both male and female flowers, disc present in both male and female flowers, styles 3-limbed with limbs spreading to divergent and 3–5-lobed. For a key to the Australian genera of the tribe *Ricinocarpeae* refer to Halford and Henderson (2005).

Ricinocarpos is widespread in Australia and is present in all states except South Australia (**Map 1**). It is notably absent from most of the arid zone, with the majority of species occurring in two disjunct regions. The greatest species concentration is in south-western Australia where fourteen species occur. The second area of concentration is in eastern Australia where ten species are recorded. Three species occur in north-western Australia and one species (*R. gloria-medii*) is from central Australia. All species are endemic in the particular region in which they occur.

Ricinocarpos pinifolius is the most wide-ranging species in the genus. It is recorded in 47 1° grid squares across an area from the central coast of Queensland southwards to southern Tasmania. By contrast, ten species (*R. brevis*, *R. caniana*, *R. gloria-medii*, *R. marginatus*, *R. oliganthus*, *R. pilifer*, *R. rosmariniifolius*, *R. ruminatus*, *R. trichophorus* and *R. tuberculatus*) have very restricted distributions each occurring in only one or two 1° grid squares throughout Australia (**Table 1**).



Map 1. Distribution of *Ricinocarpos* in Australia indicating the number of species in each1° grid square.

Species	No. of 1° grid squares	region
R. pinifolius	47	E
R. ledifolius	19	E
R. linearifolius	16	E
R. muricatus	15	SW
R. velutinus	14	SW
R. bowmanii	13	E
R. undulatus	12	SW
R. trachyphyllus	9	E
R. speciosus	8	E
R. glaucus	7	SW
R. trichophyllus	5	NW
R. megalocarpus	5	SW
R. crispatus	4	E
R. cyanescens	4	SW
R. stylosus	4	SW
R. verrucosus	3	E
R. graniticus	3	SW
R. psilocladus	3	SW
R. gloria-medii	2	C
R. caniana	2	E
R. ruminatus	2	E
R. rosmarinifolius	2	NW
R. trichophorus	2	SW
R. brevis	1	E
R. marginatus	1	NW
R. oliganthus	1	SW
R. pilifer	1	SW
R. tuberculatus	1	SW

Table 1. Frequency of ***Ricinocarpos*** species in Australia, based on the number of 1° grid squares in which they are found.

abbreviations: E = eastern Australia;
SW = south-western Australia;
NW = north-western Australia;
C = central Australia.

Classification within *Ricinocarpos*

J. Müller (1865, 1866) divided *Ricinocarpos* into three sections, namely *R.* sect *Anomodiscus*, *R.* sect. *Euricinocarpus* (*nom. inval.* = *R.* sect. *Ricinocarpos*) and *R.* sect. *Apetalidion*. These sections were based on the presence or absence of petals and disc attachment in flowers. *Ricinocarpos* sect. *Anomodiscus* contained a single species *R. major* Müll.Arg., *R.* sect. *Euricinocarpus* (= *R.* sect. *Ricinocarpos*) contained eight species, while *R.* sect. *Apetalidion* contained a single species, *R. muricatus* Müll.Arg. The eight species in *R.* sect. *Ricinocarpos* were arranged into two informal groups based on flower arrangement. Group one had flowers more or less solitary or in cymose inflorescences (*R. speciosus* Müll.Arg., *R. pinifolius* Desf., *R. cyanescens* Müll.Arg., *R. glaucus* Endl., *R. tuberculatus* Müll.Arg., *R. bowmanii* F.Muell. and *R. ledifolius*). Group two had flowers in racemose inflorescences (*R. trichophorus* Müll.Arg.).

In his account of *Ricinocarpos* in *Flora Australiensis*, Bentham (1873) recognised thirteen species, the ten species dealt with by J. Müller in de Candolle's Prodromus (1866), two new species (*R. rosmarinifolius* Benth. and *R. marginatus* Benth.) and *Bertya gummifera* var. *psiloclada* Müll.Arg which he transferred to *Ricinocarpos* as *R. psiloclada* (Müll.Arg) Benth. Bentham did not recognise any subdivisions within the genus and made no comment regarding Müller's sections. The species *R. rosmarinifolius* Benth., *R. marginatus* Benth. and *R. psiloclada* (Müll. Arg) Benth. would have been referable to *R.* sect. *Ricinocarpos* had Bentham recognised the sectional divisions established by Müller.

In the most recent and comprehensive treatment of *Ricinocarpos*, Grüning (1913) recognised fifteen species. They included the thirteen species dealt with by Bentham (1873) plus *R. velutinus* F.Muell. and *R. stylosus* Diels. Grüning grouped them into four sections, namely the three sections erected by J. Müller (1865), *R.* sect. *Euricinocarpos* Müll.Arg. (= *R.* sect. *Ricinocarpos*), *R.* sect. *Anomodiscus* Müll.Arg., *R.* sect. *Polystaphylos* Grüning (*nom. illeg.* = *R.* sect. *Apetalidion* Müll.Arg.) and a fourth *R.* sect. *Sissostylus* Grüning erected to accommodate *R. stylosus*. *Ricinocarpos velutinus* F.Muell. was placed in *R.* sect. *Ricinocarpos*.

Although the great majority (twenty five) of the species we accept occur in a single section (*R.* sect. *Ricinocarpos*), we believe that continued recognition of these sections is useful in understanding the genus. In the present account, we have maintained the sectional classification presented by Grüning (1913) except for *R.* sect. *Anomodiscus* which contains *R. major*. Bentham (1873) and Grüning (1913) both independently question the placement of *R. major* Müll.Arg. within *Ricinocarpos*. From our examination of the specimen on which this name is based (microfiche and a fragment in MEL), we believe that the taxon that it represents does not belong in *Ricinocarpos* and most probably does not belong in Euphorbiaceae. We have seen no other specimens that match this material during our studies. We have, therefore, excluded *R. major* and *R.* sect. *Anomodiscus* from the current revision.

For the distinguishing characters of the sections of *Ricinocarpos* refer to the 'taxonomy' section below. As stated previously, *Ricinocarpos* sect. *Ricinocarpos* contains the majority of species. In the following taxonomic treatment the species within *R.* sect. *Ricinocarpos* are listed alphabetically. However, although not formalised here, there are clear mophological groupings of species within this section that we suggest may reflect shared ancestry. The characters are summaried in **Table 2**. These groups are:

The *R. pinifolius* group. Young branchlets glabrous. Young shoots and buds non resinous. Adaxial surface of leaves glabrous, non resinous. Flowers solitary or in ± umbelliform inflorescences. Calyx deciduous in fruit. Petals at least twice as long as calyx. Style ± obsolete, many times shorter than stigmatic limbs. Fruit glabrous, spiculate, tuberculate, verrucose or smooth. Five species included from south-western Australia and eastern Australia: *R. cyanescens*, *R. megalocarpus*, *R. pinifolius*, *R. ruminatus* and *R. tuberculatus*.

The *R. glaucus* group. Young branchlets hairy with simple hairs in longitudinal bands. Young shoots and buds non resinous. Adaxial surface of leaves glabrous, non resinous. Flowers solitary or in ± umbelliform inflorescences. Calyx persistent in fruit. Petals at least twice as long as calyx. Style ± obsolete, many times shorter than stigmatic limbs. Fruit glabrous or hairy, smooth. Three species included from south-western Australia: *R. glaucus*, *R. pilifer* and *R. undulatus*.

The *R. psilocladus* group. Young branchlets glabrous. Young shoots and buds resinous. Adaxial surface of leaves glabrous, usually resinous. Flowers solitary or in ± umbelliform inflorescences. Calyx persistent in fruit. Petals slightly longer to twice as long as calyx. Style ± obsolete, many times shorter than stigmatic limbs. Fruit glabrous, ± smooth, resinous. Three species included from south-western Australia: *R. graniticus*, *R. oliganthus* and *R. psilocladus*.

The *R. bowmanii* group. Young branchlets stellate hairy. Young shoots and buds non resinous. Adaxial surface of leaves stellate hairy at least when young, non resinous. Flowers solitary or in ± umbelliform inflorescences. Calyx persistent in fruit. Petals slightly shorter to twice as long as calyx. Style ± obsolete, many times shorter than stigmatic limbs. Fruit densely stellate hairy. Nine species included from eastern Australia, central Australia and south-western Australia: *R. bowmanii*, *R. brevis*, *R. caniana*, *R. crispatus*, *R. gloria-medii*, *R. ledifolius*, *R. linearifolius*, *R. speciosus* and *R. trachyphyllus*.

The *R. marginatus* group. Young branchlets stellate hairy. Young shoots and buds non resinous. Adaxial surface of leaves stellate hairy at least along the margins and midline, non resinous. Flowers in ± umbelliform inflorescences. Calyx persistent in fruit. Petals ± equalling or shorter than calyx. Style conspicuous, ± equalling in length stigmatic limbs. Fruit stellate hairy. Three species included from north-western Australia: *R. marginatus*, *R. rosmarinifolius* and *R. trichophyllus*.

The *R. trichophorus* group. Young branchlets stellate hairy. Young shoots and buds non resinous. Adaxial surface of leaves stellate hairy, non resinous. Flowers in racemose inflorescences. Calyx persistent in fruit. Petals

slightly longer or up to twice as long as calyx. Style obscure, many times shorter in length than stigmatic limbs. Fruit stellate hairy. Two species included from south-western Australia: *R. trichophorus* and *R. velutinus*.

Characters		1	2	3	4	5	6
Young branchlets							
indumentum	absent	+		+			
	simple hairs		+				
	stellate hairs				+	+	+
Young shoots and buds	resinous			+			
	non resinous	+	+		+	+	+
Adaxial surface of leaves							
indumentum	absent	+	+	+			
	stellate hairs				+	+	+
resinous	resinous			+			
	non resinous	+	+		+	+	+
Arrangement of flowers	solitary	+	+	+	+		
	± umbelliform inflorescence	+	+	+	+	+	
	racemose inflorescence						+
Calyx	persistent in fruit		+	+	+	+	+
	deciduous in fruit	+					
Petals	longer than calyx	+	+	+	+		+
	equal calyx				+	+	
	shorter than calyx				+	+	
Style	± obsolete or obscure	+	+	+	+		+
	conspicuous					+	
Fruit							
indumentum	absent	+	+	+			
	stellate hairs		+		+	+	+
surface texture	smooth	+	+	+	+	+	+
	variously textured	+					
resinous	resinous			+			
	non resinous	+	+		+	+	+

Table 2. Summary of morphological characters of informal groups of ***Ricinocarpos*** sect. ***Ricinocarpos.***

1 = *R. pinifolius group*, *2* = *R. glaucus* group, 3 = *R. psilocladus* group, 4 = *R. bowmanii* group, 5 = *R. marginatus* group, 6 = *R. trichophorus* group

Materials and methods

This revision is based on an assessment of morphological characters of about 1050 dried herbarium collections, and collections and field studies undertaken by the second author from 1988 to 1992. Herbarium collections from herbaria AD, BRI, CANB, HO, MEL, NE, NSW and PERTH were studied and annotated, and selected material from B, G and K was also seen. Acronyms used here and elsewhere to indicate herbaria holding particular specimens are those listed by

Holmgren *et al.* (1990). All specimens cited have been examined by one or both of the authors, unless indicated otherwise by '*n.v*'.

Descriptions of colour for vegetative and floral parts are either from the information on herbarium labels or from photographs taken by the second author during field studies. Measurements listed are based upon the total variation observed in the herbarium specimens examined. Information on plant size, flowering and fruiting times, and habitat of occurrence was obtained from herbarium labels. All measurements were made either on fresh material, dried material, material preserved in 70% ethanol or dried material reconstituted by placing in boiling water for a few minutes. The distribution maps were produced with MapInfo Version 3 and are based on herbarium specimen locality data.

Taxonomy

Ricinocarpos Desf., *Mém. Mus. Hist. Nat.* 3: 459, t. 22 (1817). **Type:** *Ricinocarpos pinifolius* Desf.

[*Roeperia auct. non* Adr.Juss.: C.P.J.Sprengal, *Syst. Veg.* 16th edn, 3: 147 (1826)]

Monoecious or apparently sometimes dioecious **shrubs, rarely small trees**; branches glabrous or with an indumentum of stellate or rarely simple hairs. **Leaves** spirally alternate or rarely subopposite, exstipulate, petiolate or rarely sessile, simple, entire, margins flat, recurved or revolute, marginal glands absent or present on blade proximally. **Inflorescences** of a single male or female flower, or ± umbelliform with either all male flowers or one or two central female flowers surrounded by several male flowers, or racemose with all female or all male flowers or one or two female flowers basal on the axis with numerous male flowers distal to them, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet, bracteose or frondobracteose. **Flowers** mostly conspicuous, pedicellate, mostly bracteolate, gamosepalous; calyx deeply 5(rarely 4 or 6)-lobed, lobes subequal, imbricate (quincuncial); petals mostly 5(rarely 4, 6, 7 or absent), imbricate (convolute or rarely quincuncial), mostly equalling or longer than calyx; disc present, of discrete alternipetalous glands or forming a continuous glandular ring. **Male flowers:** stamens numerous (> 15), erect to spreading from central column formed by fusion of bases of filaments; anthers dorsifixed, extrorse, of two separate obloid, parallel but contiguous locules each lateral on slightly swollen connective at the apex of filament, dehiscing by longitudinal slits; pistillode absent. **Female flowers:** calyx lobes persistent or caducous; petals often marcescent; ovary 3-locular with one pendant ovule in each locule; style short or ± obsolete; stigma with 3 horizontally spreading and divergent limbs; limbs deeply 2(rarely 3 to 5)-lobed, red, persistent. **Fruits** capsular, ellipsoid, ovoid or subglobose, mostly trilobate, glabrous or densely hairy, smooth, tuberculate, rugose, verrucose or spiculate, mostly 3-seeded, separating septicidally into three 2-valved cocci leaving a persistent columella. **Seeds** ovoid to ellipsoid and usually dorsi-ventrally compressed, carunculate; testa smooth, shiny, often blotched; caruncle waxy-fleshy creamy-white to yellowish-white; endosperm copious; embryo linear, in the middle of the endosperm, cotyledons longer than the radicle.

Key to sections of *Ricinocarpos*

1. Flowers with petals and sepals . . . . . **R.** sect. **Ricinocarpos** (25 species)
   Flowers without petals (sepals only present) **2**

2. Flowers solitary or in umbelliform inflorescences . . . . . **R.** sect. **Scissostylus** (1 species)
   Flowers in racemose inflorescences . . . . . **R.** sect. **Apetalidion** (2 species)

Key to species of *Ricinocarpos*

1. Young branchlets glabrous or with minute simple hairs **2**
Young branchlets with stellate hairs **15**

2. Flowers lacking petals (sepals only present) **3**
Flowers with petals and sepals **5**

3. Leaf blades < 15 mm long (W.A.). . . . . **26. R. stylosus**
Leaf blades ≥ 15 mm long. **4**

4. Adaxial surface of calyx lobes glabrous (W.A.) . . . . . **27. R. muricatus**
Adaxial surface of calyx lobes pubescent (Qld) . . . . . **28. R. verrucosus**

5. Young branchlets minutely hairy in two longitudinal bands. **6**
Young branchlets glabrous **8**

6. Ovaries and fruits hairy (W.A.). . . . . **14. R. pilifer**
Ovaries and fruits glabrous **7**

7. Abaxial surface of leaf blades with a sericeous indumentum; hairs ± straight (W.A.) . . . . . **24. R. undulatus**
Abaxial surface of leaf blades with a woolly indumentum; hairs crispate (W.A.) . . . . . **6. R. glaucus**

8. Young shoots and flower buds resinous; adaxial surface of calyx lobes glabrous **9**
Young shoots and flower buds not resinous; adaxial surface of calyx lobes hairy. **11**

9. Leaf blades < 15 mm long (W.A.). . . . . **13. R. oliganthus**
Leaf blades ≥ 15 mm long. **10**

10. Leaf blades linear to narrow-oblong or very narrow-obovate, (1.5–) 2.5–6 mm wide, with adaxial surface tuberculate and margins recurved but with most of the abaxial surface of the leaf blade visible (W.A.) . . . . **16. R. psilocladus**
Leaf blades linear, ≤ 1.5 mm wide, with adaxial surface smooth and margins recurved to revolute so that only midrib of abaxial surface of the leaf blade is visible (W.A.) . . . . . **8. R. graniticus**

11. Fruits spiculate, densely covered with subulate processes **12**
Fruits smooth or tuberculate **13**

12. Fruits 14–16 mm long, 14–16 mm across; seeds ellipsoid, 9.5–10 mm long, 6–6.5 mm across; caruncles ruminate (Qld) . . . . . **18. R. ruminatus**
Fruits 8–12 mm long, 10–14 mm across; seeds ovoid, 5.5–9 mm long, 3.2–4.2 mm across; caruncles ± smooth (N.S.W., Qld, Tas., Vic.) . . . . **15. R. pinifolius**

13. Fruits tuberculate, 14–16 mm long, 10–13 mm across (W.A.) . . . . . **12. R. megalocarpus**
Fruits smooth to tuberculate, 10–12 mm long, 5–8 mm across **14**

14. Leaf blades 7–12 mm long, 1–1.7 mm wide, with a length/width ratio < 12:1 (W.A.) . . . . . **5. R. cyanescens**
Leaf blades 10–25 mm long, 0.8–1.3 mm wide, with a length/width ratio ≥ 12:1 (W.A.) . . . . . **23. R. tuberculatus**

15. Inflorescences terminal, racemose **16**
Inflorescences terminal or axillary, of a single flower or umbelliform **17**

16. Young shoots and inflorescence with a ferruginous indumentum; adaxial surface of leaf blades stellate-pubescent when young soon becoming glabrous; petals white (W.A.) . . . . . **21. R. trichophorus**
Young shoots and inflorescence with a greyish-white indumentum; adaxial surface of leaf blades with moderately dense indumentum of persistent stellate hairs; petals yellow (W.A.) . . . . . **25. R. velutinus**

17. Petals < 3.5 mm long **18**
Petals ≥ 3.5 mm long **21**

18. Leaf blades ≥ 8 mm wide, margins ± flat (W.A.) . . . . . **11. R. marginatus**
Leaf blades < 8 mm wide, margins recurved **19**

19. Leaf blades < 20 mm long (W.A.) . . . . . **2. R. brevis**
Leaf blades ≥ 20 mm long **20**

20. Adaxial surface of leaf blades moderately to densely stellate-pubescent; hairs with a short stout stipe (N.T., W.A.) . . . . . **22. R. trichophyllus**
Adaxial surface of leaf blades ± glabrous except for scattered sessile stellate hairs especially along the midline (W.A.) . . . . . **17. R. rosmarinifolius**

21. Petals < 6 mm long **22**
Petals ≥ 6 mm long **25**

22. Margins of leaf blades recurved with most of the abaxial surface of the leaf blade visible (Qld) . . . . . **9. R. ledifolius**
Margins of leaf blades recurved to revolute so that only the midrib of the abaxial surface of the leaf blade is visible **23**

23. Fruits < 7 mm long (Qld) . . . . . **4. R. crispatus**
Fruits ≥ 7 mm long **24**

24. Abaxial surface of leaf blades with a pubescent indumentum (W.A.) . . . . . **2. R. brevis**
Abaxial surface of leaf blades with a sericeous indumentum (N.S.W., Qld) . . . . . **10. R. linearifolius**

25. Adaxial surface of leaf blades hairy becoming glabrous and scabrid by the persistent tuberculate bases of deciduous hairs **26**
Adaxial surface of leaf blades stellate-pubescent when young becoming glabrous and smooth **27**

26. Abaxial surface of leaf blades pubescent with stellate hairs up to 0.4 mm across (N.S.W.) . . . . . **1. R. bowmanii**
Abaxial surface of leaf blades sericeous with stellate hairs up to 2 mm across (N.S.W., Qld) . . . . . **20. R. trachyphyllus**

27. Leaf blades ≥ 7 mm wide (N.S.W., Qld) . . . . . **19. R. speciosus**
Leaf blades < 7 mm wide **28**

28. Margins of leaf blades recurved with most of the abaxial surface of the leaf blade visible (Qld) . . . . . **3. R. caniana**
Margins of leaf blades recurved to revolute so that only the midrib on the abaxial surface of the leaf blade is visible **29**

29. Abaxial surface of leaf blades with a sericeous indumentum; petioles < 2 mm long (N.S.W., Qld) . . . . . **10. R. linearifolius**
Abaxial surface of leaf blades with a tomentose indumentum; petioles 2–3 mm long (N.T.) . . . . . **7. R. gloria-medii**

Regional keys

The following regional keys are given as supplementary to the general key because the identification of a specimen belonging to *Ricinocarpos* is much simplified if the geographical source is known.

Key to species of *Ricinocarpos* in south-western Australia

1. Young branchlets with stellate hairs **2**
Young branchlets glabrous or with minute simple hairs **4**

2. Inflorescences terminal or axillary, of a single flower or umbelliform . . . . . **2. R. brevis**
Inflorescences terminal, racemose **3**

3. Young shoots and inflorescence with a ferruginous indumentum; adaxial surface of leaf blades stellate-pubescent when young soon becoming glabrous; petals white . . . . . **21. R. trichophorus**
Young shoots and inflorescence with a greyish-white indumentum; adaxial surface of leaf blades with moderately dense indumentum of persistent stellate hairs; petals yellow . . . . . **25. R. velutinus**

4. Flowers lacking petals (sepals only present) **5**
Flowers with petals and sepals **6**

5. Leaf blades < 15 mm long, inflorescences of a single flower or umbelliform . . . . . **26. R. stylosus**
Leaf blades ≥ 15 mm long; inflorescences racemose . . . . . **25. R. muricatus**

6. Young branchlets minutely hairy in two longitudinal bands **6**
Young branchlets glabrous **8**

6. Ovaries and fruits hairy . . . . . **14. R. pilifer**
Ovaries and fruits glabrous **7**

7. Abaxial surface of leaf blades with sericeous indumentum; hairs ± straight . . . . . **24. R. undulatus**
Abaxial surface of leaf blades with woolly indumentum; hairs crispate . . . . . **6. R. glaucus**

8. Young shoots and flower buds resinous; adaxial surface of calyx lobes glabrous **9**
Young shoots and flower buds not resinous; adaxial surface of calyx lobes hairy **11**

9. Leaf blades < 15 mm long . . . . . **13. R. oliganthus**
Leaf blades ≥ 15 mm long **10**

10. Leaf blades linear to narrow-oblong or very narrow-obovate, (1.5–) 2.5–6 mm wide, with adaxial surface tuberculate and margins recurved but with most of the abaxial surface of the leaf blade visible . . . . . **16. R. psilocladus**
Leaf blades linear ≤ 1.5 mm wide, with adaxial surface smooth and margins recurved to revolute so that only midrib of abaxial surface of the leaf blade is visible . . . . . **8. R. graniticus**

11. Fruits tuberculate, 14–16 mm long, 10–13 mm across . . . . . **12. R. megalocarpus**
Fruits smooth to tuberculate, 10–12 mm long, 5–8 mm across **12**

12. Leaf blades 7–12 mm long, 1–1.7 mm wide, with a length/width ratio < 12:1 . . . . . **5. R. cyanescens**
Leaf blades 10–25 mm long, 0.8–1.3 mm wide, with a length/width ratio ≥ 12:1 . . . . . **23. R. tuberculatus**

Key to species of *Ricinocarpos* in eastern Australia

1. Young branchlets glabrous or with minute simple hairs **2**
Young branchlets with stellate hairs **4**

2. Flowers lacking petals (sepals only present); fruits tuberculate (Qld) . . . **26. R. verrucosus**
Flowers with petals and sepals; fruits spiculate, densely covered with subulate processes **3**

3. Fruits 8–12 mm long, 10–14 mm across; seeds ovoid, 5.5–9 mm long, 3.2–4.2 mm across; caruncles ± smooth (N.S.W., Qld, Tas., Vic.) . . . . . **15. R. pinifolius**
Fruits 14–16 mm long, 14–16 mm across; seeds ellipsoid, 9.5–10 mm long, 6–6.5 mm across; caruncles ruminate (Qld) . . . . . **18. R. ruminatus**

4. Petals < 6 mm long **5**
Petals ≥ 6 mm long **7**

5. Margins of leaf blades recurved with most of the abaxial surface of the leaf blade visible (Qld) . . . . . **9. R. ledifolius**
Margins of leaf blades recurved to revolute so that only the midrib of the abaxial surface of the leaf blade is visible **6**

6. Fruits < 7 mm long (Qld) . . . . . **4. R. crispatus**
Fruits ≥ 7 mm long(N.S.W., Qld) . . . . . **10. R. linearifolius**

7. Adaxial surface of leaf blades hairy becoming glabrous and scabrid by the persistent tuberculate bases of deciduous hairs **8**
Adaxial surface of leaf blades stellate-pubescent when young becoming glabrous and smooth **9**

8. Abaxial surface of leaf blades pubescent with stellate hairs up to 0.4 mm across (N.S.W.) . . . . . **1. R. bowmanii**
Abaxial surface of leaf blades sericeous with stellate hairs up to 2 mm across (N.S.W., Qld). . . . . **20. R. trachyphyllus**

9. Leaf blades ≥ 7 mm wide (N.S.W., Qld) . . . . . **19. R. speciosus**
Leaf blades < 7 mm wide **10**

10. Margins of leaf blades recurved with most of the abaxial surface of the leaf blade visible (Qld) . . . . . **3. R. caniana**
Margins of leaf blades recurved to revolute so that only the midrib of the abaxial surface of the leaf blade is visible (N.S.W., Qld). . . . . **10. R. linearifolius**

Key to species of *Ricinocarpos* in north-western and central Australia

1. Petals > 5 mm long (N.T.) . . . . . **7. R. gloria-medii**
Petals < 5 mm long **2**

2. Leaf blades ≥ 8 mm wide, margins ± flat (W.A.) . . . . . **11. R. marginatus**
Leaf blades < 8 mm wide, margins recurved **3**

3. Adaxial surface of leaf blades moderately to densely stellate-pubescent; hairs with short stout stipes (N.T., W.A.) . . . . . **22. R. trichophyllus**
Adaxial surface of leaf blades ± glabrous except for scattered sessile stellate hairs especially along the midline (W.A.) . . . . . **17. R. rosmarinifolius**

Ricinocarpos Desf. sect. **Ricinocarpos**, Müll.Arg., *Linnaea* 34: 59 (1865). **Type:** *R. pinifolius* Desf.

Ricinocarpos sect. *Bertya* F.Muell., *Fragm.* 1: 76 (1859). **Type:** *Ricinocarpos ledifolius* F.Muell.

Ricinocarpos sect. *Euricinocarpus* Müll.Arg., *Linnaea* 34: 59 (1865), *nom. inval.*

Leaves with petiole spreading from branchlet. Inflorescences of a single male or female flower, or ± umbelliform with either all male flowers or one or two central female flowers surrounded by several male flowers. Flowers petaliferous. Stigmatic limbs deeply 2-lobed.

1. Ricinocarpos bowmanii F.Muell., *Fragm.* 1: 181/182 (1859) (‘*Ricinocarpus Bowmani*’); *Roeperia bowmanii* (F.Muell.) Kuntze, *Revis. Gen. Pl.* 2: 618 (1891); *Ricinocarpos bowmanii* F.Muell. var. *bowmanii*, Maiden & Betche, *Proc. Linn. Soc. New South Wales* 23: 776 (1899). **Type:** [New South Wales.] lower Macquarie River, *s.d.*, *E.M.Bowman s.n.* (holo: MEL 2062913; iso: K [element on the right side of the sheet; element on the left side of sheet is not part of the type collection]).

Ricinocarpos puberulus Baill., *Adansonia* 6: 295 (1866). **Type:** [New South Wales.] Port Jackson, *s.d.*, *C.Gaudichaud s.n.* (holo: P 152761).

Ricinocarpos bowmanii var. *albus* Maiden & Betche, *Proc. Linn. Soc. New South Wales* 23: 776 (1899) (‘*Ricinocarpus Bowmani* var. *albus*’). **Type:** [New South Wales.] Bomera, Oct 1898, *W.MacDonald s.n.* (holo: NSW [2 sheets 464878, 438911]; iso: BRI [AQ 205160]).

Ricinocarpos bowmanii var. *planus* Grüning in A. Engler, *Pflanzenr.* H.58: 43 (1913) (‘*Ricinocarpus Bowmanii* var. *plana*’). **Type:** [New South Wales.] “Neusüdwales: The Rock bei Wagga Wagga, (*Phillips*)” (holo: ?; iso: K, NSW 464908).

Ricinocarpos bowmanii var. *genuinus* Grüning in A. Engler, *Pflanzenr.* H.58: 43 (1913) (‘*Ricinocarpus Bowmanii* var. *genuina*’), *nom. inval.*

***Illustrations*:** James & Harden (1990: pl. 23); Elliot & Jones (2002: 235).

Monoecious or apparently dioecious, spreading **shrubs** to 1 m high, shoot apices and flower buds with ferruginous indumentum. Young branchlets ± terete, with a dense grey-white indumentum, glabrescent though remaining tuberculate by persistent hair bases; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.4 mm across, with stipes < 0.1 mm long. Older branchlets with surface becoming shallowly longitudinally reticulately fissured, ± grey. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 1–2 mm long, densely hairy with hairs as for branchlets; blades narrow-oblong to oblong, narrow-obovate, narrow-ovate or rarely linear, (7–) 10–22 (–35) mm long, (1–) 1.5–5 mm wide, with a length/width ratio of 3–15:1; adaxial surface stellate-pubescent but becoming scabrid by the persistent tuberculate bases of deciduous hairs; abaxial surface pubescent with soft white stellate hairs up to 0.4 mm across; base cuneate; margins recurved usually to midrib; apex obtuse; midvein obscure or slightly impressed adaxially, abaxially raised and stellate-pubescent;

secondary venation obscure on both surfaces; marginal glands absent or present on blade, up to 1 mm from base, 1 each side of midrib, stipitate, smooth, *c.* 0.1 mm across; stipes up to 0.4 mm long. **Inflorescences** of a single male or female flower or ± umbelliform with either 2–6 male flowers or one central female flower surrounded by up to 4 male flowers, terminal on branchlets; bracts narrow-ovate, 4–8 mm long, glabrous adaxially, stellate-pubescent abaxially; bracteoles narrow-ovate or narrow-oblong, 2–4.5 mm long, glabrous adaxially, stellate-pubescent abaxially. **Flowers** conspicuous; pedicel densely hairy with ferruginous stellate hairs; calyx 5-lobed; petals 5–7, *c.* twice as long as calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 2.5–11 (–23) mm long; calyx densely tomentose with ferruginous and greyish-white stellate hairs abaxially, white stellate-tomentose adaxially, lobes ovate to elliptic, 3–6 mm long, 3–4 mm wide, acute to rounded at the apex; petals broad-ovate or broad-elliptic, 10–13 mm long, 6–10 mm wide, white or pale pink, glabrous, with margins entire, rounded or obtuse at the apex; disc-glands 0.6–0.7 mm long, dorsi-ventrally compressed, glabrous, rounded to truncate at the apex; central column 3–5 mm long, tomentose; stamens 35–60; free portion of filaments 1.3–2.3 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.9 mm long. **Female flowers:** pedicel usually stout, 5–9 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes narrow-ovate, 5–6 mm long, 2.5–3 mm wide, acute to obtuse at the apex; petals narrow-obovate to obovate or semi-elliptic, 8.5–12 mm long, 3.5–6 mm wide, white or pale pink, glabrous, with margins entire, rounded at the apex, marcescent; disc-glands as for male flowers; ovary ellipsoid, 2.5–3 mm long, densely stellate-villose with reddish-brown hairs; style *c.* 0.5 mm long, glabrous; stigmatic limbs 3.5–4.5 mm long, glabrous; lobes spreading to ± downwardly curving, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, trilobate, 9–11 mm long, 8–11 mm across, stellate-villose, usually 3-seeded; calyx a quarter to half the length of mature fruit. **Seeds** ovoid or ellipsoid, dorsi-ventrally compressed, 6.5–7.5 mm long (including caruncle), 3.5–4 mm wide, 3.2–3.4 mm deep; testa dark brown; caruncle ± hemispherical, 1–2 mm long, 1.5–2.3 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 71 examined)*: New South Wales.** Adelong Falls, 1.8 km NNW of Adelong on Tumblong road, Oct 1980, *Coveny 10770 & Hind* (MEL, NSW); Pilliga S.F., 0.4 km W along Burma road from Newell Highway, Aug 1987, *Coveny 12737 et al.* (MEL, PERTH); Pilliga S.F., 0.4 km W along Burma road from Newell Highway, Aug 1987, *Coveny 12742 et al.* (BRI, MEL, PERTH); 98.5 km SW of Narrabri, Oct 1969, *Coveny 2336* (NSW); Pilliga Nature Reserve, No. 1 Break road, 78 km from Narrabri on Newell Highway, Nov 1993, *Forster PIF14197 & Machin* (BRI, NSW); *c.* 36 km NNE of Coonabarabran on Newell Highway to Narrabri, Sep 1989, *Henderson & Turpin H3241* (BRI, NSW); on Newell Highway, *c.* 13 km N of Narrabri, near Telecom C-N12 post, Oct 1990, *Henderson & Turpin H3482* (BRI); Goonoo State Forest, 11 km S of Mendooran, Sep 1989, *Jobson 857 & Lum* (MEL); Bohena Creek, 14 miles [*c.* 22 km] S of Narrabri; E Pilliga S.F., Nov 1954, *Johnson & Constable s.n.* (NSW 30368); 31.3 km N of Oxley Highway intersection on Newell Highway towards Narrabri, Oct 1993, *Johnstone 420b & Burrell* (NSW); 16 km NE of Tumut, Brungle Gap, Honeysuckle Range, Jul 1993, *Makinson 1276 & Butler* (CANB, NSW); 22 km NE of Tumut on the Tumut-Wee Jasper road, Aug 1982, *Norris 809* (MEL, NSW); 10 miles [*c.* 16 km] from Mendooran towards Gilgandra, Oct 1967, *Shoobridge s.n.* (CANB [CBG023519]); Lightning Ridge, Coolac, Sep 1989, *Specht 7* (BRI, NSW); 4 km E of Koorowatha, Sep 1980, *Streimann 8100* (CANB); 61 km from Coonabarabran on Narrabri road [Newell Highway], Dec 1973, *Streimann HS657* (CANB); Kangaroo Mt, near Coolac, Aug 1966, *Whaite & Whaite 3095* (NSW); Pilliga Scrub, Burma road, *c.* 0.5 km from Newell Highway, Aug 1987, *Wiecek 176 et al.* (NSW).

***Distribution and habitat*:** *Ricinocarpos bowmanii* occurs on the western slopes and western plains of New South Wales, from Pilliga and Narrabri south to Wagga Wagga and near Tumut (**Map 2**). It is recorded as growing on sandy soils in open eucalypt forest or woodland communities, or on rocky sites on open forested hillsides.

***Phenology*:** Flowers have been collected in January, April and from July to November, fruits from September to December.

***Affinities*:** *Ricinocarpos bowmanii* is similar to *R. caniana* Halford & R.J.F.Hend., *R. gloriamedii* J.H.Willis, *R. linearifolius* Halford & R.J.F.Hend. and *R. trachyphyllus* Halford & R.J.F.Hend. For features distinguishing

R. bowmanii from *R. caniana*, *R. linearifolius* and *R. trachyphyllus*, refer to the 'Affinities' section under the species concerned. *Ricinocarpos bowmanii* can be distinguished from *R. gloria-medii* by its generally shorter leaves that are narrow-oblong to oblong, narrow-obovate, narrow-ovate or rarely linear in outline and the scabrid adaxial surface of the leaf blade.

2. Ricinocarpos brevis R.J.F.Hend. & Mollemans, **species nova** *R. crispato* Halford & R.J.F.Hend. in Terra Reginae austro-occidentali crescentem maxime affinis sed habitu generaliter plus intricate ramoso et fructibus majoribus (8–9 mm longis × 6–7 mm latis non 4–5 mm longis × 5–6 mm latis) differt. *R. gloria-medii* J.H.Willis ab Australia centrali nec non affinis sed foliorum lamina breviore (usque ad 30 mm longa non 25–60 mm longa), floribus petalis brevioribus (2.3–5.8 mm longis non 6–11 mm longis), floribus masculis androecii columna breviore (usque ad 3 mm longa non 6–7 mm longa) et staminibus paucioribus (20–30 non 70–80), floribus femineis stigmatum lobis valde brevioribus (0.7–1.5 mm longis non 3–4 mm longis), et fructu minore, 8–9 mm longo et 6–7 mm lato non 10–11 mm longo et 10–11 mm lato differt. Frutex usque ad 1.8 m altus; foliorum lamina angusto-oblonga marginibus plerumque costae revolutis, supra sparsim stellata-pilosa, infra dense stellata-pilosa; flores solitarii vel in fasciculis umbellae formibus florum 2 vel 3 in ramulis terminantibus; ovarium stellatum-pilosum. **Typus:** Western Australia. 7 km N of Windarling Peak, 112 km N of Southern Cross, 23 June 1990, *F.H. & M.P.Mollemans 2961* (holo: PERTH; iso: BRI [2 sheets]).

Monoecious or apparently dioecious densely and intricately twiggy **shrubs** 1–1.8 m high. Young branchlets terete, with a dense greyish-white indumentum; hairs stellate, ± sessile or shortly stipitate, multiangulate, < 0.2 mm long, with stipes < 0.1 mm long. Older branchlets with surface becoming shallowly longitudinally reticulately fissured, ± greyish in colour. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 0.9–2 mm long, densely hairy with hairs as for branchlets; blades narrow-oblong, (4–) 7–30 mm long, 1.4–2 (–4) mm across, with a length/width ratio of 4–12:1; adaxial surface stellate-pubescent but becoming scabrid by the persistent tuberculate bases of deciduous hairs; abaxial surface floccosely hairy below with soft white stellate hairs up to 0.5 mm across; base obtuse to cuneate; margins usually recurved to midrib; apex obtuse; midvein slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or occasionally present on blade, up to 3 mm from blade base, 1 per side of midrib, sessile, smooth, *c.* 0.1 mm across. **Inflorescences** of a single male or female flower, or umbelliform with either two female flowers or one female and one or two male flowers, terminal on branchlets; bracts and bracteoles narrow-ovate, 1.5–2 mm long, glabrous adaxially, stellate-pubescent abaxially, caducous. **Flowers** conspicuous; pedicel densely hairy with mostly white stellate hairs; calyx 5-lobed; petals 5, slightly shorter to a little longer than calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 4–8 mm long; calyx white-woolly stellate hairy abaxially and adaxially, sometimes flecked with red abaxially, lobes ovate to semi-elliptic, 3.8–4.7 mm long, 2–3 mm wide, acute, obtuse or rounded at the apex; petals ovate, 4.3–5.8 mm long, 2.5–3.2 mm wide, white with veins outlined with red colouration, glabrous, with margins few-notched, acute to obtuse at the apex; disc-glands 0.4–0.5 mm long, compressed and truncate-lacerate distally, hairy both adaxially and abaxially with dense, dendritic hairs; central column 2.5–3 mm long, tomentose; stamens 25–45; free portion of filaments 0.8–1.5 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel usually stout, 2–5 (–7) mm long; calyx persistent, whitish-grey stellate-pubescent abaxially and adaxially, lobes ovate to semi-elliptic, 3–3.1 mm long, 1.8–2.6 mm wide, acute at the apex; petals elliptic to rhomboidal, 2.3–4.1 mm long, 1.5–1.8 mm wide, white but turning brown, glabrous, with margins entire, acute or obtuse at the apex, marcescent; disc-glands 0.3–0.4 mm long, compressed and ± entire but fimbriate distally, hairy adaxially with dense, dendritic hairs, glabrous abaxially; ovary ovoid but 3-sulcate, 3.5–4.2 mm long, densely

loosely stellate-pubescent; style ± obsolete; stigmatic limbs 0.7–1.5 mm long, glabrous adaxially, stellate-pubescent proximally abaxially; lobes spreading to ± upwardly curving, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal to ovoid, 8–9 mm long, 6–7 mm across, stellate-pubescent, usually 3-seeded; calyx a quarter to half the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 5.5 mm long (including caruncle), 4 mm wide, and 2.7 mm deep; testa pale brown and blotched with dark brown; caruncle ± reniform, *c.* 1.5 mm long and 2.2 mm wide, ± smooth, yellowish-white. **Fig. 1.**

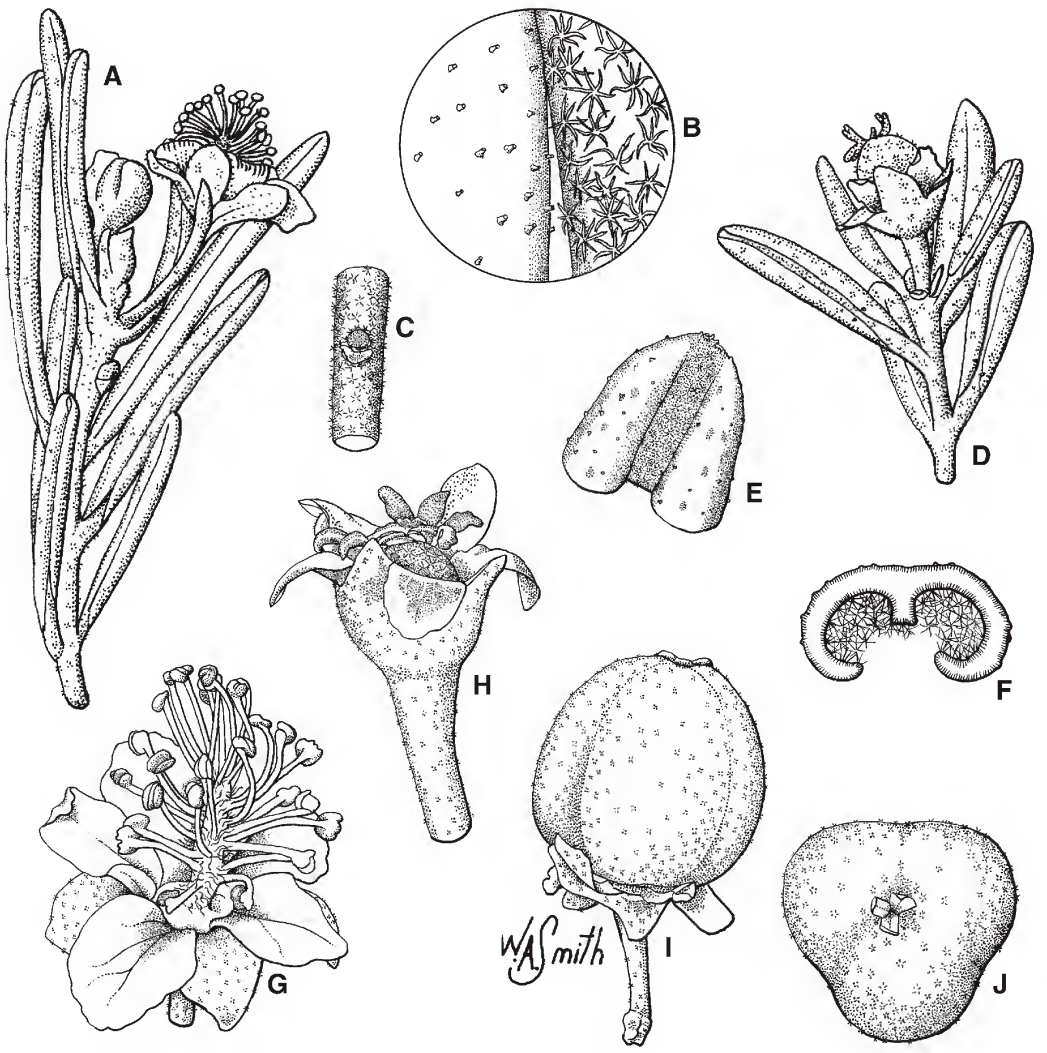


Fig. 1. ***Ricinocarpos brevis.*** A. branchlet with male flower × 3. B. adaxial leaf surface showing indumentum × 36. C. branchlet showing stellate indumentum × 6. D. branchlet with fruit × 3. E. leaf apex × 12. F. transverse section of leaf × 12. G. side view of male flower × 6. H. side view of female flower × 6. I. side view of fruit × 4. J. face view of fruit × 4. A, B, E–H from *Mollemans 2961 & Mollemans* (BRI); C, D from *Mollemans 3087 & Mollemans* (BRI); I, J from *Mollemans 3773 & Mollemans* (BRI). Del. W.Smith.

***Additional specimens examined*: Western Australia.** Windarling Range, *c.* 120 km N of Bullfinch, Nov 2001, *Bull s.n.* (PERTH 06334393); 7 km N of Windarling Peak, 112 km N of Southern Cross, Jun 1990, *Mollemans & Mollemans 2977* (BRI); *loc. cit.*, 11 July 1990, *Mollemans & Mollemans 3087, 3090, 3091* (BRI); *loc. cit.*, 12 July 1990, *Mollemans & Mollemans 3094, 3095, 3099* (BRI); *loc. cit.*, Oct 1990, *Mollemans & Mollemans 3771, 3772, 3773, 3774* (BRI); Windarling Range, Jun 2003, *Vincent 1.1* (PERTH).

***Distribution and habitat*:** *Ricinocarpos brevis* is known only from the Windarling Range, north of Southern Cross in Western Australia (**Map 3**). It appears to be confined to a specific habitat, namely shallow sandy soils on rocky banded ironstone outcrops at about 500 to 550 m altitude. At these places, the species occurs in mixed shrublands with *Acacia*, *Grevillea* and/or *Eremophila* species.

***Phenology*:** Flowers have been collected in June, July and November, fruits in October and November.

***Affinities*:** *Ricinocarpos brevis* is similar to *R. crispatus* Halford & R.J.F.Hend. from south-western Queensland but differs from that in its generally more intricately branched habit and its larger fruits (8–9 mm long × 6–7 mm across compared with 4–5 mm long × 5–6 mm across). It is also allied to *R. gloria-medii* J.H.Willis from central Australia but differs from that in its generally shorter leaves (up to 30 mm long compared with 25–60 mm long), its smaller flowers, its shorter petals in both male and female flowers (up to 5 mm long compared with 7–11 mm long), its male flowers with a shorter androecium column (up to 3 mm long compared with 6–7 mm long) and fewer stamens (20–30 compared with 70–80), its female flowers with much shorter stigmatic limbs (up to 1.5 mm long compared with 3–4 mm long), and its smaller fruit (8–9 mm long × 6–7 mm across compared with 10–11 mm long × 10–11 mm across).

***Etymology*:** The specific epithet, from Latin *brevis* (short) refers to the comparatively short blade and petiole of the leaves and the pedicel of the flowers in this species.

3. Ricinocarpos caniana Halford & R.J.F.Hend. **species nova** *R. bowmanii* F.Muell. et *R. linearifolio* Halford & R.J.F.Hend. maxime affinis. Ab illo foliis linearibus, 45–100 mm longis non oblongis, angusto-oblongis, angusto-obovatis, angusto-ovatis vel raro linearibus et (7–) 10–22 (–35) mm longis, petiolo longiore (2.5–4 mm longo non 1–2 mm longo), pagina adaxiali plus minusve laevi non scabrida et pagina abaxiali sericea non pubescenti clare differt. Ab hoc foliorum lamina longiore et latiore (45–100 mm longa × 2–4 mm lata non (8–) 15–45 (–50) mm longa × 1–1.3 mm lata) et petiolo longiore (2.5–4 mm longo non 0.8–1.5 mm longo) differt. **Typus:** Queensland. Burnett District: near Dripping Rock, Cania Gorge National Park, 25 October 1999, *D.A.Halford Q3841* (holo: BRI; iso: BRI, MEL, NSW, distribuendi).

Ricinocarpos sp. (Cania Gorge K.A.Williams 80221), Forster & Halford (2002: 73; 2007: 72).

***Illustration*:** Williams (1987: 340) as *R. ledifolius*.

Monoecious or dioecious, erect **shrubs** to 2 m high, shoot apices and flower buds with ferruginous indumentum. Young branchlets ± terete, with a dense greyish-white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.5 mm across, with stipes < 0.1 mm long. Older branchlets with surface becoming shallowly longitudinally fissured, pale reddish-brown. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 2.5–4 mm long, densely hairy with hairs as for branchlets; blades linear, 45–100 mm long, 2–4 mm wide, with a length/width ratio of 15–45:1; adaxial surface stellate-pubescent when young but soon becoming glabrous and ± smooth; abaxial surface sericeous with loosely appressed soft stellate hairs up to 1.5 mm across; base cuneate or truncate; margins slightly recurved in fresh state, recurved to revolute when dried; apex acute and ultimately mucronate with extension from midrib; midvein obscure or slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands present on blade, up to 1 mm from base, 1 each side of midrib, ± sessile or shortly stipitate, smooth, *c.* 0.1 mm across; stipes < 0.1 mm long. **Inflorescences** of a single male or female flower, or umbelliform with either 2–5 male flowers or one(rarely 2) female flowers surrounded by up to 4 male flowers, terminal

on branchlets; bracts linear to lanceolate, 10–11 mm long, ± glabrous adaxially, densely stellate-pubescent abaxially, readily caducous; bracteoles lanceolate, 5–7 mm long, glabrous abaxially, sparsely stellate-pubescent adaxially, caducous. **Flowers** conspicuous; pedicel tomentose with ferruginous and greyish-white stellate hairs; calyx 5-lobed; petals 5, slightly longer than calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 9–17 mm long; calyx densely tomentose with ferruginous and greyish-white stellate hairs abaxially, white stellate-tomentose adaxially, lobes ovate to elliptic, 4.3–5.8 mm long, 2.2–3 mm wide, acute at the apex; petals ovate, *c.* 9 mm long and 4.7 mm wide, white, glabrous, with margins entire, rounded or obtuse at the apex; disc-glands 0.5–0.6 mm long, dorsi-ventrally compressed, glabrous, rounded to truncate at the apex; central column *c.* 4 mm long, tomentose; stamens *c.* 50; free portion of filaments 2–2.5 mm long, erect to spreading or decurving at anthesis, glabrous; anthers 0.4–0.6 mm long. **Female flowers:** pedicel stout, 7–14 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate, 4.5–5 mm long, 2.2–3 mm wide, acute at the apex; petals obovate, 7–7.5 mm long, 3–3.5 mm wide, white, glabrous, with margins entire, obtuse to rounded at the apex, marcescent; disc-glands as for male flowers; ovary subglobose, 3-sulcate, *c.* 3.8 mm long, densely stellate-villose; style *c.* 0.3 mm long, stellate-pubescent; stigmatic limbs *c.* 2 mm long, glabrous adaxially, scattered stellate hairs proximally abaxially; lobes ± spreading, ± dorsi-ventrally compressed but shallowly grooved abaxially, smooth on both surfaces. **Fruits** subglobose, trilobate, 10–11 mm long, 10–11 mm across, stellate-villose, usually 3-seeded; calyx ± half the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 6.3 mm long (including caruncle), 3 mm wide and 2.6 mm deep; testa dark red-brown; caruncle ± hemispherical, *c.* 1 mm long and 1.3 mm wide, ± smooth, white. **Fig. 2.**

***Additional specimens examined*: Queensland.** Burnett District: *c.* 19 km NW of Monto at Cania Gorge, Aug 1982, *Anderson 3170* (BRI); Cania Gorge N.P., Oct 1983, *Henderson H2943 et al.* (BRI); Dripping Rock, Cania Gorge N.P., *c.* 24 km NW of Monto, Oct 1987, *Henderson H3105* (BRI); Cania Gorge, Aug 1996, *Telford 12319, 12320* (BRI); Cania Gorge, near Dripping Rock, Aug 1980, *Williams 80221* (BRI).

***Distribution and habitat*:** *Ricinocarpos caniana* is known only from Cania Gorge near Monto in south-eastern Queensland (**Map 4**). It is recorded as growing in open *Eucalyptus*, *Lophostemon* forest with a dense shrubby understorey on shallow sandy soils between sandstone rocks on steep talus slope in a narrow gorge.

***Phenology*:** Flowers have been collected in August, fruits in October.

***Affinities*:** *Ricinocarpos caniana* is similar to *R. bowmanii* and *R. linearifolius*. It is easily distinguished from *R. bowmanii* by its linear leaf blades which are 45–100 mm long as compared with oblong to narrow-oblong, narrow-obovate, narrow-ovate or rarely linear leaf blades which are (7–) 10–22 (–35) mm long in that species, its longer petioles which are 2.5–4 mm long compared with 1–2 mm long in that species, its ± smooth rather than scabrid adaxial surface of the leaf blades and its sericeous rather than pubescent indumentum on the abaxial surface of the leaf blades. It differs from *R. linearifolius* by its generally longer and broader leaf blades (45–100 mm long × 2–4 mm wide compared with (8–) 15–45 (–50) mm long × 1–1.3 mm wide in that species), and its longer petioles which are 2.5–4 mm long compared with 0.8–1.5 mm long in the latter species.

***Etymology*:** The specific epithet *caniana* is derived from Cania Gorge, the area in south-eastern Queensland where this species occurs.

4. Ricinocarpos crispatus Halford & R.J.F.Hend. **species nova** *R. brevi* R.J.F.Hend. & Mollemans a Australia Occidentali australi maxime affinis etiam *R. gloria-medii* J.H.Willis ab Australia centrali affinis. Ab illo habitu minore intricate ramoso et fructibus minoribus (4–5 mm longis × 5–6 mm latis non 8–9 mm longis × 6–7 mm latis) differt. Ab hoc foliis plerumque brevioribus (15–25 (–35) mm longis non 25–60 mm longis), floribus minoribus sepalis et petalis brevioribus in floribus masculinis et femineis (sepala 3–4 mm longa non 4.5–8 mm longa et petala 3.8–5 mm longa non 7–11 mm longa), floribus masculinis androecii columna breviore (2.5–3 mm longa non 6–7 mm

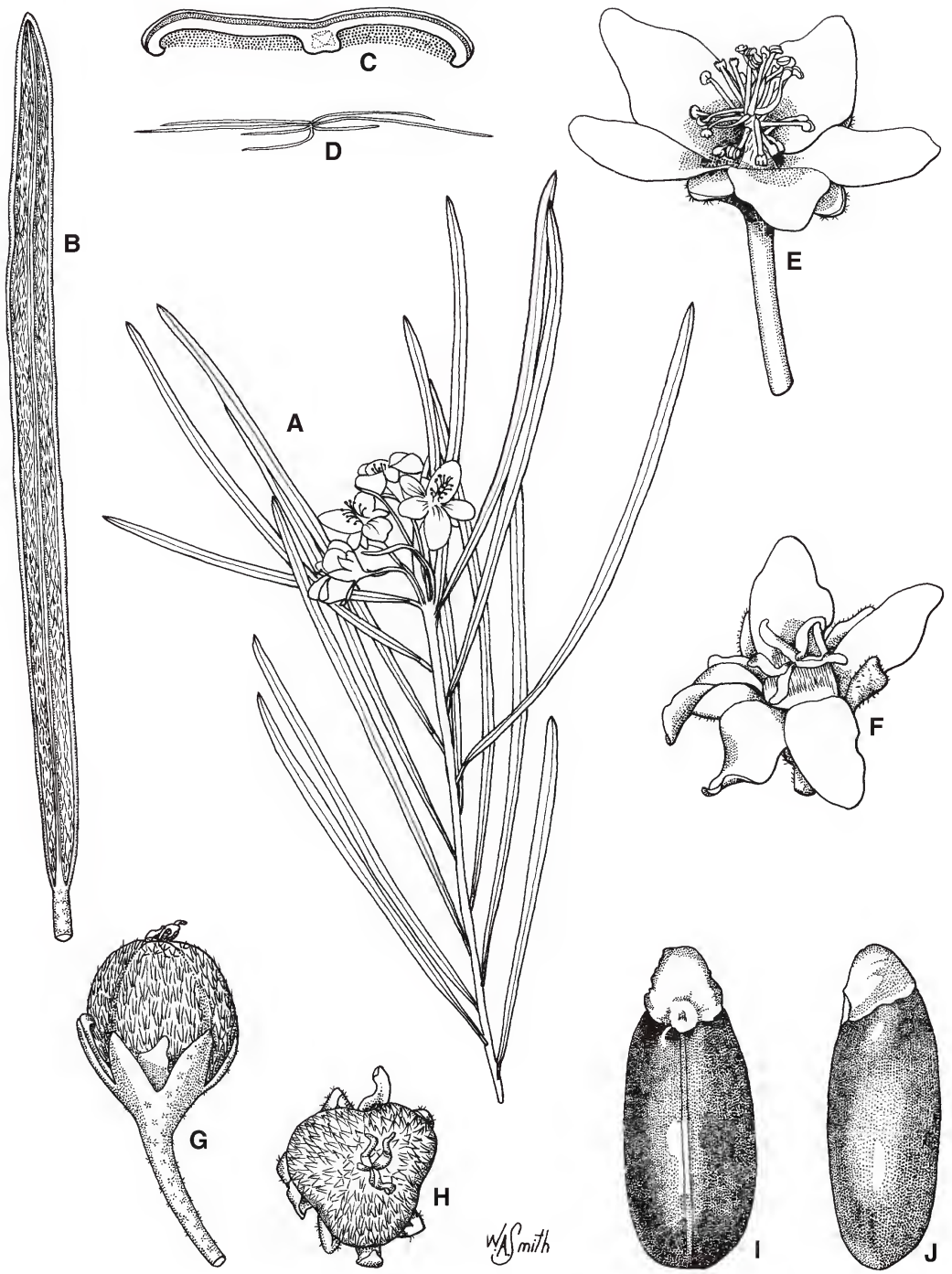


Fig. 2. ***Ricinocarpos caniana.*** A. flowering branchlet × 0.8. B. adaxial leaf surface showing indumentum × 2. C. transverse section of leaf × 16. D. stellate hair, from abaxial leaf surface × 32. E. side view of male flower × 3. F. side view of female flower × 3. G. side view of fruit × 2. H. face view of fruit × 2. I. ventral view of seed × 6. J. side view of seed × 6. A, E from *Telford 12320* (BRI); B–D, G, H from *Henderson H3105* (BRI); F from *Telford 12319* (BRI); I, J from *Halford Q3841* (BRI). Del. W.Smith.

longa) et staminibus paucioribus (20–30 non 70–80), floribus femineis stigmatis limbis multo brevioribus (1–1.5 mm longis non 3–4 mm longis) et fructibus minoribus (4–5 mm longis × 5–6 mm latis non 10–11 mm longis × 10–11 mm latis) differt. **Typus:** Queensland. Warrego District: Mariala National Park, *c.* 130 km NW of Charleville, 31 July 1991, *R.J.F.Henderson & G.Turpin H3538* (holo: BRI; iso: CANB, DNA, MEL, NSW, PERTH, distribuendi).

Ricinocarpos sp. (Mt Calder Station M.E.Ballingall MEB1588), Forster & Halford (2002: 73; 2007: 72).

Monoecious or dioecious **shrubs** to 2 (–3.5) m high. Young branchlets terete, with a dense greyish-white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.2 mm across, with stipes < 0.1 mm long. Older branchlets with surface becoming shallowly fissured, ± dark grey. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 1.2–3 mm long, densely hairy with hairs as for branchlets; blades linear, 15–25 (–35) mm long, 1–2 mm wide, with a length/width ratio of 9–16 (–20):1; adaxial surface stellate-pubescent but becoming glabrous and smooth or scabrid by the persistent tuberculate bases of deciduous hairs; abaxial surface floccosely hairy with soft white stellate hairs up to 0.2 mm across; base cuneate; margins recurved to revolute to midrib; apex obtuse to rounded, gland-tipped; midvein slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or occasionally present on blade, up to 1 mm from base, 1 per side of midrib, sessile, smooth, *c.* 0.1 mm across. **Inflorescences** of a single male or female flower, or umbelliform with either 2–4 male flowers or one female flower surrounded by up to 2 male flowers, terminal on branchlets; bracts and bracteoles linear, 2–2.5 (–4) mm long, glabrous adaxially, densely stellate-pubescent abaxially, readily caducous. **Flowers** ± inconspicuous; pedicel densely hairy with mostly greyish-white stellate hairs; calyx 5-lobed; petals 5, slightly longer than calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 3–14 mm long; calyx densely pubescent with greyish-white stellate hairs abaxially; white stellate-pubescent adaxially, lobes ovate, 3–4 mm long, 1.8–2.3 mm wide, acute or obtuse at the apex; petals obovate, 4–5 mm long, 2.3–2.6 mm wide, white, glabrous, with margins crispate, rounded at the apex; disc-glands 0.4–0.5 mm long, dorsi-ventrally compressed, stellate-pubescent distally adaxially, ± glabrous abaxially, rounded at the apex; central column 2.5–3 mm long, tomentose; stamens 20–30; free portion of filaments 0.5–0.8 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.4 mm long. **Female flowers:** pedicel stout, 3–12 (–16) mm long; calyx persistent, indumentum as for calyx of male flowers, lobes 3.4–4 mm long, 1.8–2.1 mm wide, acute to obtuse at the apex; petals obovate, 3.8–4.1 mm long, 1.8–2.2 mm wide, white, glabrous, with margins crispate, obtuse to rounded at the apex, marcescent; disc-glands as for male flowers; ovary ovoid but 3-sulcate, *c.* 2.3 mm long, densely loosely stellate-pubescent; style ± obsolete; stigmatic limbs 1–1.5 mm long, glabrous adaxially, stellate-pubescent proximally abaxially; lobes spreading to ± upwardly curving, keeled and verrucose adaxially, flat and smooth abaxially. **Fruits** depressed globose, trilobate, 4.5–5 mm long, 5–6 mm across, stellate-pubescent, usually 3-seeded; calyx *c.* half the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 4.2 mm long (including caruncle), 2.7 mm wide and 2.2 mm deep; testa dark red-brown; caruncle ± reniform, *c.* 0.4 mm long and 1.8 mm wide, ± smooth, yellowish-white. **Fig. 3.**

***Additional specimens examined*: Queensland.** Mitchell District: Idalia N.P., Dec 1993, *Addicott 3* (BRI); Mt Calder Station, Blackall–Adavale road, Sep 1984, *Ballingall 1588* (BRI); *c.* 4 km W of Tomahawk Hut, Mt Calder Station, Aug 1991, *Henderson & Turpin H3540* (BRI). Warrego District: W of 'One Stone Hill' on Lisburne Station between Blackall and Adavale, Grey Range, Jul 1989, *Allen 12* (BRI); Mariala N.P. on Adavale road, 7.1 km W of earth Tank, Apr 1995, *Ballingall 2738* (BRI); *c.* 12 km directly SW of Mt Calder Station homestead, Aug 1991, *Henderson & Turpin H3542* (BRI); 'Lisburne', 108 km NE of Adavale, Dec 1984, *McRae 3* (BRI); 1 km E of Idalia N.P. headquaters, 113 km SW of Blackall, May 2000, *Nicholls SN181* (BRI); Ambathala Range area, 50 km E of Adavale, May 1979, *Sandercoe 191* (BRI).

***Distribution and habitat*:** *Ricinocarpos crispatus* is confined to south-western Queensland where it occurs in scattered

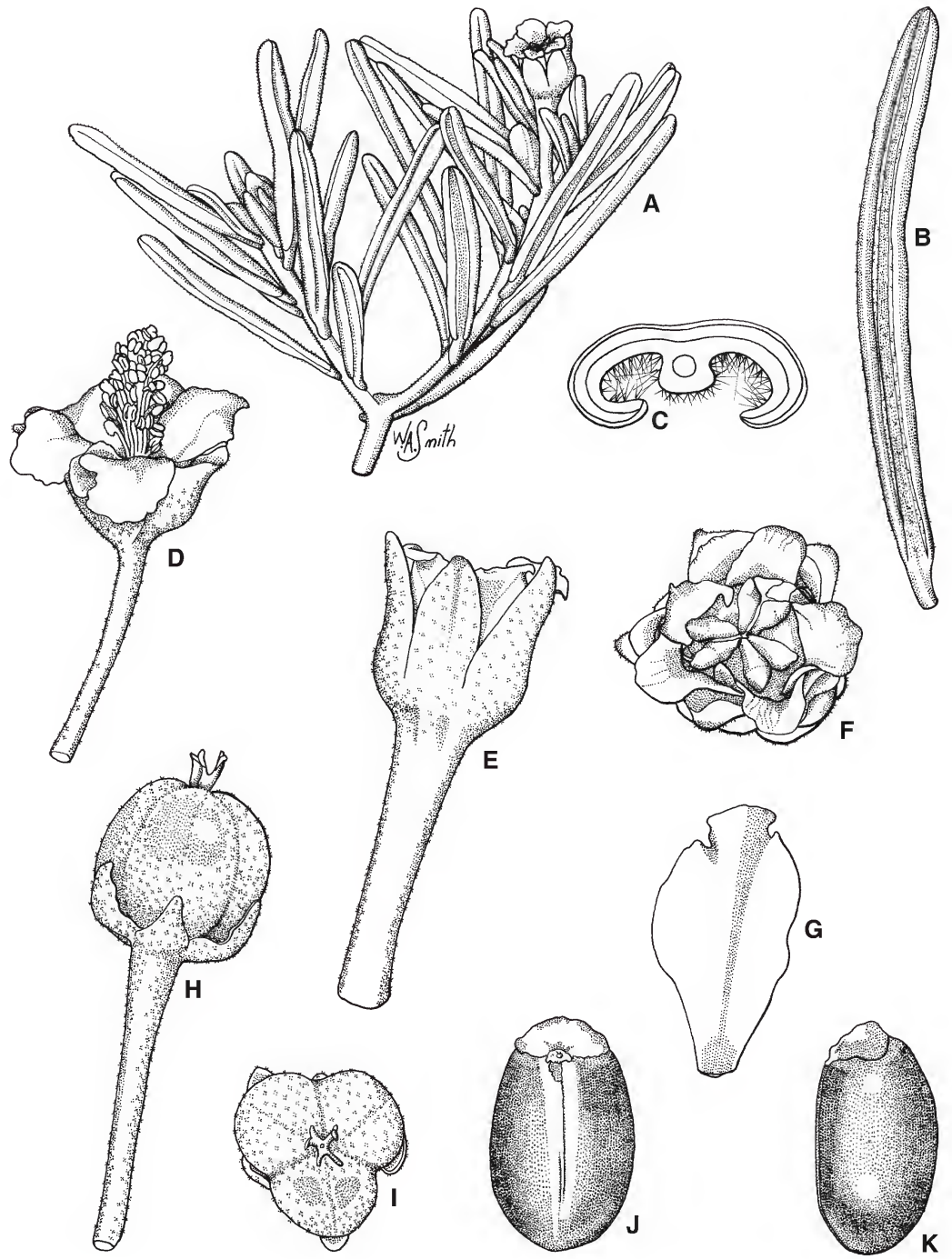


Fig. 3. *Ricinocarpos crispatus*. A. flowering branchlet × 2. B. adaxial leaf surface × 4. C. transverse section of leaf × 18. D. side view of male flower × 6. E. side view of female flower × 6. F. face view of female flower × 8. G. adaxial view of petal × 12. H. side view of fruit × 4. I. face view of fruit × 4. J. ventral view of seed × 8. K. side view of seed × 8. A–C from *Henderson & Turpin H3538* (BRI); D from *Henderson & Turpin H3540* (BRI); E–K from *Ballingall 1588* (BRI). Del. W.Smith.

populations in an area more or less bounded by Blackall, Quilpie and Charleville (**Map 5**). It is recorded growing as a component of shrubland communities commonly dominated by *Acacia catenulata* on red clay soils, with outcropping rocks on slopes and crests of low isolated dissected tablelands.

***Phenology*:** Flowers have been collected in August and December, fruits in May and September.

***Affinities*:** *Ricinocarpos crispatus* is similar to *R. brevis* R.J.F.Hend. & Mollemans from southern Western Australia but is also allied to *R. gloria-medii* J.H.Willis from central Australia. It differs from the former by its less intricately branched habit and its smaller fruits which are 4–5 mm long × 5–6 mm across compared with 8–9 mm long × 6–7 mm across in *R. brevis*. From the latter, it differs in its generally shorter leaves which are 15–25 (–35) mm long compared with 25–60 mm long, its smaller male and female flowers which both have shorter sepals and petals (sepals which are 3–4 mm long compared with 4.5–8 mm long and petals which are 3.8–5 mm long compared with 7–11 mm long), its male flowers with a shorter androecium column and fewer stamens (the androecium column is 2.5–3 mm long compared with 6–7 mm long, and the stamens number 20–30 compared with 70–80), its female flowers with much shorter stigmatic limbs which are 1–1.5 mm long compared with 3–4 mm long , and its smaller fruit which are 4–5 mm long × 5–6 mm across compared with 10–11 mm long × 10–11 mm across in *R. gloria-medii*.

***Etymology*:** The specific epithet is from Latin *crispatus* (irregularly waved and twisted), in reference to the wavy margins of petals in both male and female flowers of this species.

5. Ricinocarpos cyanescens Müll.Arg., *Linnaea* 34: 60 (1865) (‘*Ricinocarpus*’); *Ricinocarpos glaucus* var. *cyanescens* (Müll. Arg.) Baill., *Adansonia* 6: 296 (1866); *Roeperia cyanescens* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 618 (1891). **Type:** [Western Australia.] in Nova Hollandia austro-occidentali ad Swan River, *s.d.*, *J.Drummond ser. 3 no. 15* (syn: ?, *n.v.*; isosyn: K, MEL 2062915, P 199397); *loc. cit., ser. 3 no. 86* p.p. (syn: ?, *n.v.*).

Monoecious, compact **shrubs** to 2 m high. Young branchlets subterete, glabrous, ± glaucous. Older branchlets with surface becoming tessellated and flaky, pale brown or greyish in colour. **Leaves** petiolate, spirally alternate; petioles 1–2 mm long, glabrous; blades narrow-oblong, 7–12 mm long, 1–1.7 mm wide, with a length/width ratio of 5–8:1; adaxial surface glabrous, ± smooth; abaxial surface puberulous with soft white crispate hairs up to 0.2 mm long; base cuneate; margins recurved to midrib so that only midrib of abaxial surface of leaf blade is visible; apex obtuse to rounded, ultimately mucronate with extension from midrib; mucro slightly downwardly curved, up to 0.3 mm long; midvein obscure adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–4 male flowers or one female flower surrounded by up to 2 male flowers, terminal on branchlets; bracts narrow-ovate, 4–8 mm long, glabrous adaxially, stellate-pubescent abaxially, caducous; bracteoles absent. **Flowers** conspicuous; pedicel glabrous; calyx 5-lobed; petals 5, *c.* twice as long as calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 5–16 mm long; calyx glabrous abaxially, densely hairy with white crispate hairs adaxially, lobes triangular, 1.5–2 mm long, 1–1.5 mm wide, acute at the apex; petals narrow-obovate, 6–11 mm long, 2–3 mm wide, white, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins entire, obtuse to rounded at the apex; disc-glands 0.2–0.3 mm long, dorsi-ventrally compressed, glabrous, rounded-sinuate at apex; central column 2.5–3 mm long, glabrous; stamens 20–30; free portion of filaments 0.3–0.6 mm long, ± erect at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel usually stout, 3–10 long; calyx caducous, indumentum as for calyx of male flowers, lobes ± triangular, 2–2.5 mm long, 1.4–1.8 mm wide, acute at the apex; petals narrow-obovate, 6–7 mm long, 2–2.5 mm wide, white, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins entire, obtuse or rounded at the apex, caducous; disc-glands

as for male flowers; ovary ovoid, *c.* 3 mm long, glabrous, verrucose; style ± obsolete; stigmatic limbs of unknown colour when fresh, 1.5–1.7 mm long, glabrous; lobes spreading to ± downwardly curving, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, 10–11 mm long, 5–6 mm across, glabrous, verrucose, usually 1-seeded. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 7.3 mm long (including caruncle), 4 mm wide and 3.5 mm deep; testa pale brown and blotched with dark brown; caruncle ± concial, *c.* 1.7 mm long and 2 mm wide, ± smooth, yellowish-white.

***Additional specimens examined*: Western Australia.** Mt Hamilla, Stirling Range, Oct 1968, *Canning WA/68 6154* (CANB, MEL); 35 km S of Arthur River, Oct 1983, *Cranfield 4679* (CANB); 4.5 km NE of Metricup, May 1996, *Davis 630* (CANB); Donnelly Peak, Stirling Range, Nov 1934, *Gardner s.n.* (PERTH); near Boscabel turnoff, on Albany Highway, Dec 1966, *Lullfitz 5835* (PERTH); Toolbrunup, Stirling Range, Nov 1935, *Steedman s.n.* (PERTH); 10 km W of Kojonup, Nov 1978, *Wittwer W2238* (PERTH).

***Distribution and habitat*:** *Ricinocarpos cyanescens* is confined to south-western Western Australia where it occurs from near Metricup, Arthur River, Boscabel, Kojinup, Cranbrook and the Stirling Ranges (**Map 6**). This poorly collected species is recorded as growing on mostly sandy soils in open forest or woodland.

***Phenology*:** Flowers have been collected from October to December, fruits in October.

***Affinities*:** *Ricinocarpos cyanescens* is similar to *R. tuberculatus* Müll.Arg. but differs from that in having generally shorter leaves, 1-seeded fruits and a verrucose fruit surface.

6. Ricinocarpos glaucus Endl. in S.F.L. Endlicher *et al.*, *Enum. Pl.* 18/19 (1837) ('*Ricinocarpus*'); *Ricinocarpos glaucus* Endl. var. *glaucus*, Baill., *Adansonia* 6: 296 (1866); *Roeperia glauca* (Endl.) Kuntze, *Revis. Gen. Pl.* 2: 618 (1891). **Type:** [Western Australia.] King Georges Sound, *s.d.*, [*K.A.A.*] *Hügel s.n.* (holo: W, *n.v.* [photo BRI]).

Ricinocarpos glaucus var. *jasminoides* Baill., *Adansonia* 6: 296 (1866). **Type:** [Western Australia.] Plantagenet and Stirling Range, *s.d.*, [without collector] (neo [here chosen]: MEL 2062912).

Ricinocarpos glaucus var. *genuinus* Müll. Arg. in A. DC., *Prodr.* 15(2): 205 (1866), *nom. inval.*

***Illustration*:** Elliot & Jones (2002: 235).

Monoecious or dioecious, erect open **shrubs** to 2 m high. Young branchlets subterete, moderately to densely hairy in two longitudinal bands; hairs simple, erect, up to 0.2 mm long. Older branchlets with surface becoming shallowly longitudinally fissured, greyish-white. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 1–2 mm long, densely hairy adaxially with ± appressed simple hairs up to 0.4 mm long, glabrous abaxially; blades linear to narrow-oblong, (7–) 10–40 mm long, 0.8–2 mm wide, with a length/width ratio of 8–33:1; adaxial surface glabrous, smooth; abaxial surface woolly with soft white crispate hairs up to 1.2 mm long; base cuneate; margins recurved usually to midrib; apex acute and ultimately mucronate with extension from midrib; mucro straight or slightly upwardly curved, up to 0.4 mm long; midvein slightly impressed adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–4 male flowers or one female flower surrounded by up to 3 male flowers, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet; bracts narrow-ovate, 2–3 mm long, stellate-pubescent on adaxial surface and margins, glabrous abaxially; bracteoles sometimes absent, when present narrow-ovate, 1.5–2 mm long, stellate-pubescent adaxially, glabrous abaxially. **Flowers** conspicuous; pedicel ± glabrous; calyx 5-lobed; petals 5, up to three times as long as calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 7–25 mm long; calyx glabrous abaxially, densely hairy with white crispate hairs adaxially, lobes triangular or rarely ovate, 1.5–3 mm long, (0.7–) 1–2 (–3) mm wide, acute at the apex; petals narrow-oblong or narrow-obovate, (4–) 5–12 mm long, 1.5–2.7 mm wide, white, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins entire, rounded or obtuse at the apex; disc-glands 0.5–0.7

mm long, dorsi-ventrally compressed, hairy adaxially with ± erect simple hairs, ± glabrous abaxially, rounded or truncate-sinuate at apex; central column 2.5–3 mm long, glabrous; stamens 20–35; free portion of filaments 0.5–1.3 mm long, erect to spreading at anthesis, glabrous; anthers 0.4–0.7 mm long. **Female flowers:** pedicel stout, 7–20 (–40) mm long; calyx persistent, indumentum as for calyx of male flowers, lobes triangular, 1.5–2 mm long, 0.7–1 mm wide, acute at the apex; petals narrow-oblong or narrow-obovate, 7–10 mm long, 1.6–2 mm wide, white, glabrous except for scattered simple hairs proximally on adaxial surface, with margins entire, obtuse at the apex, caducous; disc-glands as for male flowers; ovary ovoid but 3-sulcate, 1.6–2.3 mm long, glabrous, smooth; style *c.* 0.3 mm long, glabrous; stigmatic limbs 0.3–1.3 mm long, glabrous; lobes spreading to ascending, ± terete, ± smooth. **Fruits** oblong in outline, strongly trilobate, 6.5–8 mm long, 4.5–6.5 mm across, glabrous, ± smooth, usually 3-seeded; calyx *c.* a fifth the length of mature fruit. **Seeds** obloid, *c.* 6.5 mm long (including caruncle), 2.7 mm wide and 2.2 mm deep; testa pale brown and blotched with dark brown; caruncle ± hemispherical, *c.* 1 mm long and 1.8 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 39 examined)*: Western Australia.** Porongorup Range, Oct 1962, *Aplin 2162* (PERTH); Shannon Mill, Nornalup–Manjinup, Oct 1967, *Ashby 2371* (PERTH); Castle Rock in Nornalup N.P., near Walpole, Oct 1967, *Belcher & Belcher 346* (MEL, PERTH); Mt Frankland, W of Albany, Sep 1966, *Bennett 1167* (PERTH); 4 miles [6.6 km] W of Denmark, Manjimup road, Oct 1962, *Fairall 618* (PERTH); Davidson road, Barlee Brook crossing, 35 km WNW [of] Manjimup PO (Post Office), Oct 1982, *Forbes 1160* (MEL, PERTH); Mt Frankland road, *c.* 22 km N of Walpole, 5 km E of Thompsons road, Dec 1985, *Foreman 1496* (MEL, PERTH); 5 km ENE of junction of Broke Inlet road and Chesapeake road, NW of Walpole, Oct 1988, *Fox 88/309* (CANB, MEL); Margaret River, Oct 1940, *Gardner 5598* (PERTH); Cape Riche, Oct 1928, *Gardner 2155* (PERTH); N of Walpole, Oct 1955, *Gauba WA1089* (CANB); Woodlands road, Porongurup Range, 35 km NNE [of] Albany, Oct 1986, *Keighery 8468* (PERTH); Boulder Hill, Betty's Beach, 32 km E of Albany, Jul 1986, *Keighery 8266* (PERTH); Albany, King George Sound, *s.d.*, *Lea s.n.* (PERTH); *c.* 9 km direct NNW of Albany at Willyung Hill, Nov 1992, *Lyne 968 et al.* (BRI, MEL); Mt Clare, Walpole, Nov 1969, *Mann & George 91* (PERTH); Devils Slide, Porongorup Range, Oct 1963, *Rogerson 38* (PERTH); South Porongurup Range, 1.5 km SW of Nancy Peak, Nov 1989, *Spencer 297 & Walsh* (MEL); 7 km W of Walpole, Oct 1967, *Wilson 6319* (CANB, PERTH); 7 km W of Walpole, Oct 1967, *Wilson 6320* (CANB, MEL, PERTH).

***Distribution and habitat*:** *Ricinocarpos glaucus* is confined to south-western Western Australia where it occurs from near Margaret River eastwards to Cape Riche east of Albany (**Map 7**). It is recorded as growing in a variety of habitats: gently undulating terrain on orange sandy clay in tall forest with karri and red tingle; sandstone hills; on top of a rocky granite rise in low mallee heath community; loam over granite in jarrah woodland; loamy lateritic soil in grassy heathland; on hilltop on coarse sandy loam over clay in jarrah mallee.

***Phenology*:** Flowers have been collected from June to December, fruits from September to December.

***Affinities*:** *Ricinocarpos glaucus* is similar to *R. pilifer* Halford & R.J.F.Hend and *R. undulatus* Lehm. For features distinguishing *R. glaucus* from *R. pilifer* refer to the 'Affinities' section under that species. It differs from *R. undulatus* in having a woolly indumentum with crispate hairs on the abaxial surface of leaf blades and white petals.

***Typification*:** In the protologue of *Ricinocarpos glaucus* var. *jasminoides*, Baillon (1866) cited "F. Mueller, Plantagenet et Stirling Range (herb.)". A request for material from P and MEL revealed a single specimen at MEL [2062912] with a blue label that has in a single hand "Ricinocarpos glaucus Endl. Plantagenet & Stirling Range". This label has been annotated in another unknown hand with "(jasminoides)". We have been unable to confirm whether this is at least part of the material sent to Baillon or even whether it is part of the original material. We have therefore nominated it as the neotype. The specimen agrees with the brief description in Baillon's protologue of *Ricinocarpos glaucus* var. *jasminoides*.

7. Ricinocarpos gloria-medii J.H.Willis, *Muelleria* 3: 95, t.5, 6 (1975). **Type:** [Northern Territory] Simpsons Gap, Macdonnell Ranges, 19 June 1972, *H.A.Morrison s.n.* (holo: MEL 501448; iso: AD, DNA).

***Illustration*:** Willis (1975: pl. 5 and pl. 6 *pro parte*).

Monoecious or dioecious, spreading, twiggy **shrubs** to 2 m high, shoot apices and flower buds with ferruginous indumentum. Young branchlets terete, with a dense grey-white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.3 mm across, with stipes < 0.1 mm long. Older branchlets with surface becoming shallowly, longitudinally, reticulately fissured, ± grey. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 2–3 mm long, densely hairy with hairs as for branchlets; blades linear or very narrow-obovate, 25–60 mm long, 1.3–3.5 mm wide; with a length/width ratio of 20–40:1; adaxial surface stellate-pubescent, somewhat glabrescent, smooth; abaxial surface tomentose with soft white stellate hairs up to 0.8 mm across; base cuneate; margins recurved often to midrib; apex obtuse; midvein slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or present on blade, up to 30 mm from base, 1 each side of midrib, sessile, smooth, *c.* 0.2 mm across. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–4 male flowers or one central female flower surrounded by up to 4 male flowers, terminal on branchlets; bracts and bracteoles linear-oblong, 1–6 mm long, stellate-pubescent adaxially and abaxially. **Flowers** conspicuous; pedicel densely hairy with greyish-white and ferruginous stellate hairs; calyx 5-lobed; petals 5, equalling or slightly longer than calyx; disc a glandular ring. **Male flowers:** pedicel slender, 7–17 mm long; calyx densely tomentose with greyish-white and ferruginous stellate hairs abaxially and adaxially, lobes ovate, 4.5–7 mm long, 3–4 mm wide, acute to obtuse at the apex; petals obovate, 7–11 mm long, 3–5 mm wide, white or cream, glabrous, with margins few-notched and undulate, obtuse to rounded at the apex; disc *c.* 0.3 mm long, dorsi-ventrally compressed, densely stellate-pubescent adaxially, ± glabrous abaxially, truncate-sinuate distally; central column 6–7 mm long, sparsely stellate-pubescent; stamens 70–80; free portion of filaments 1.5–2 mm long, erect at anthesis, glabrous; anthers *c.* 0.8 mm long. **Female flowers:** pedicel stout, 10–15 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate, 6.5–8 mm long, 3–4 mm wide, acute at the apex; petals obovate, 6–8 mm long, 3–4 mm wide, white or cream, glabrous, with margins entire, obtuse to rounded at the apex, marcescent; disc as for male flowers; ovary subglobose, *c.* 3 mm long, densely loosely stellate-pubescent; style ± obsolete; stigmatic limbs 3–5 mm long, glabrous adaxially, stellate-pubescent proximally abaxially; lobes spreading to ± upwardly curving, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** subglobose, 10–11 mm long, 10–11 mm across, stellate-pubescent, usually 3-seeded; calyx ± equal to the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 6.5 mm long (including caruncle), 4 mm wide and 3 mm deep; testa pale brown; caruncle ± hemispherical, *c.* 1 mm long and 1.3 mm wide, ± wrinkled, yellowish-white.

***Selected specimens* (*from 9 examined*): Northern Territory.** Simpsons Gap N.P., Jun 1974, *Henshall 462* (BRI, MEL, NSW, PERTH); Simpsons Gap N.P., Jun 1974, *Henshall 461* (BRI, MEL, NSW, PERTH); 4 km W of Trephina Gorge, Jul 1983, *Latz 9588* (NSW); N'Dhala Gorge, Oct 1986, *Leach 938* (BRI); N'Dhala Gorge Scenic Reserve, Aug 1987, *Meredith et al. ANBG1858* (CANB); Simpsons Gap, Macdonnell Ranges, Jun 1972, *Morrison s.n.* (BRI [AQ198263], PERTH); Simpsons Gap, Macdonnell Ranges, Jun 1974, *Willis et al. s.n.* (BRI [AQ198264], PERTH).

***Distribution and habitat*:** *Ricinocarpos gloria-medii* is confined to the Macdonnell Ranges, Northern Territory, where it is known from Trephrina Gorge, Simpsons Gap and N'Dhala Gorge (**Map 8**). It is recorded as growing in sheltered areas such as dry watercourses and at cliff bases on steep slopes of quartzite and sandstone hills.

***Phenology*:** Flowers have been collected in June and July, fruits in October.

***Affinities*:** *Ricinocarpos gloria-medii* is similar to *R. bowmanii*, *R. brevis* and *R. crispatus*. For features distinguishing *R. gloria-medii* from *R. brevis* and *R. crispatus*, refer to the 'Affinities' section under the species concerned. *Ricinocarpos gloria-medii* can be distinguished from

R. bowmanii by its generally longer leaves that are linear or very narrow-obovate in outline and the smooth adaxial surface of the leaf blades.

8. Ricinocarpos graniticus Halford & R.J.F.Hend. **species nova** *R. psiloclado* (Müll. Arg.) Benth., similiter ab Australia Occidentali australi-occidentali, maxime affinis sed foliorum lamina angustiore (1.2–1.5 mm lata non (1.5–) 2.5–7 mm lata) pagina adaxiali laevi non tuberculata et marginibus recurvatis vel revolutis ad costam paginam abaxialem occultantibus praeter costam non tantum plus minusve recurvatis differt. **Typus:** Western Australia. Herne Hill, Darling Range, 27 September 2004, *P.I.Forster PIF30387* (holo: PERTH; iso: BRI, MEL, NSW).

Monoecious **shrubs** up to 2 m high, resinous on shoots and inflorescences. Young branchlets ± angular, longitudinally striate in dried state, glabrous. Older branchlets with surface becoming tessellated, ± grey. **Leaves** mostly crowded towards the ends of short lateral branchlets, petiolate, spirally alternate; petioles 1–2 mm long, glabrous; blades linear, 15–40 mm long, 1.2–1.5 mm wide, with a length/width ratio of 10–17:1; adaxial surface glabrous and smooth; abaxial surface tomentose with shortly stipitate white stellate hairs up to 0.7 mm across; base cuneate; margins recurved to revolute to midrib so that only midrib of abaxial surface of leaf blade is visible; apex obtuse to rounded, ultimately gland-tipped with short mucro from midrib; midvein impressed adaxially, abaxially raised, glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent or present on blade, up to 1 mm from base, 1 each side of midrib, sessile, smooth, *c.* 0.1 mm across. **Inflorescences** of a single male or female flower, or ± umbelliform with one female flower surrounded by up to 2 male flowers, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet; bracts and bracteoles oblong, 1–2 mm long, glabrous, resinous, caducous. **Flowers** conspicuous; pedicel glabrous; calyx 5-lobed; petals 5, *c.* twice as long as calyx. **Male flowers:** pedicel slender, 6–9 mm long; calyx glabrous abaxially and adaxially, sometimes with scattered minute stellate hairs on margins, resinous abaxially, lobes ovate, 4–4.2 mm long, 2.5–2.6 mm wide, obtuse to rounded at the apex; petals lanceolate or oblong, 6–8 mm long, 1.5–2.4 mm wide, creamy-white, glabrous, with margins entire, rounded to obtuse at the apex; disc a glandular ring, dorsi-ventrally compressed, *c.* 0.3 mm long, glabrous, sinuate, irregularly lobed distally; central column *c.* 3 mm long, glabrous; stamens *c.* 35; free portion of filaments 1–1.5 mm long, ± erect at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers** not seen; pedicel stout, 5–10 mm long in fruit. **Fruits** ellipsoid, trilobate, *c.* 7 mm long and 6.5 mm across, glabrous, ± smooth, 3-seeded; calyx half to two thirds the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, *c.* 4.5 mm long (including caruncle), 3 mm wide and 2.5 mm deep; testa pale brown; caruncle ± hemispherical, *c.* 0.8 mm long and 1.5 mm wide, ± smooth, greyish-white. **Fig. 4.**

***Additional specimens examined*: Western Australia.** Gorge, Helena Valley, Aug 1987, *Cole s.n.* (PERTH); Pages Way, Gosnells, Sep 1978, *Cranfield 509* (CANB, MEL, PERTH); between Bottle Rock and Dragon Rock, Jun 1970, *George 9893* (BRI, PERTH); Dragon Rocks Nature Reserve on track *c.* 2 km NW of junction of Dragon Rocks road and Newdegate road North, Aug 1986, *Hopper 5269* (BRI); William St, Herne Hill, Jun 1986, *Patrick 254* (PERTH); Padbury ave, Herne Hill, Jun 1985, *Patrick 165* (PERTH); *c.* 300 m E of Range road, adjacent to E end of William Street, Herne Hill, Nov 1989, *Patrick s.n.* (BRI); Helena Valley, Jun 1978, *Seabrook 559* (PERTH).

***Distribution and habitat*:** *Ricinocarpos graniticus* is confined to south-western Western Australia where it is restricted to a small area of the Darling Range east of Perth with a disjunct population at Dragon Rock Nature Reserve north of Newdegate (**Map 9**). It is recorded as growing on granite outcrops, in low scrub with *Corymbia calophylla* and *Eucalyptus wandoo* in a gully at the base of granite sheet and on a small granite exposure fringed by *Thryptomene australis*, *Hakea petiolaris* and *Acacia lasiocalyx*.

***Phenology*:** Flowers have been collected in June, August and September, fruits from August to November.

***Affinities*:** *Ricinocarpos graniticus* is similar to *R. psilocladus* (Müll.Arg.) Benth., also

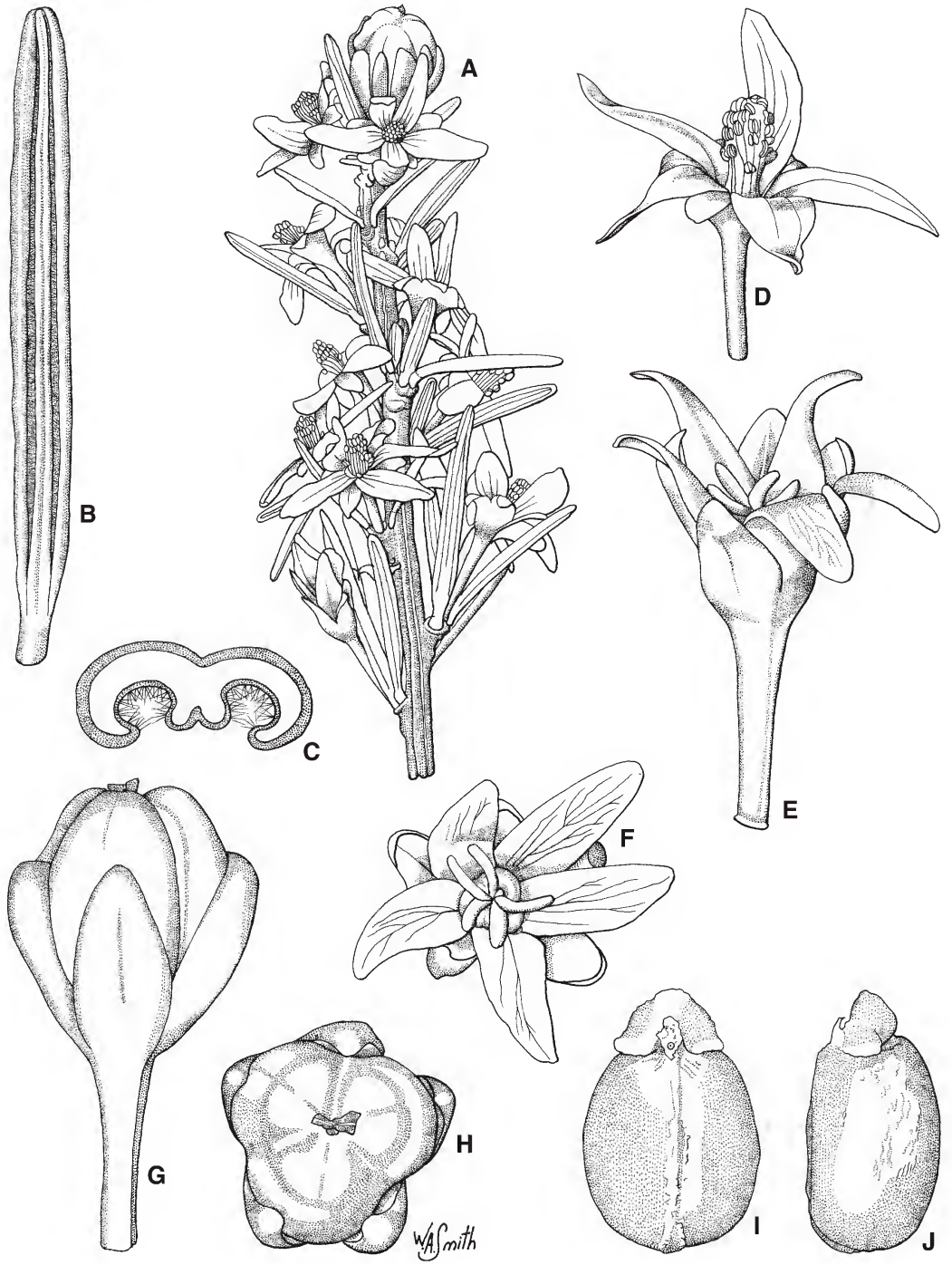


Fig. 4. ***Ricinocarpos graniticus.*** A. flowering and fruiting branchlet × 2. B. adaxial leaf surface × 4. C. transverse section of leaf × 16. D. side view of male flower × 4. E. side view of female flower × 4. F. face view of female flower × 4. G. side view of fruit × 4. H. face view of fruit × 4. I. ventral view of seed × 8. J. side view of seed × 8. A–J from *Forster PIF30387* (BRI). Del. W.Smith.

from the south-west of Western Australia, but can be distinguished from that species by its narrower leaf blades (1.2–1.5 mm wide compared with (1.5–) 2.5–7 mm wide in the latter species) with the adaxial surface smooth rather than tuberculate and with the margins recurved to revolute to the midrib to hide the abaxial surface except for the midrib, not merely somewhat recurved.

***Etymology*:** The specific epithet refers to granite rock outcrops upon or near where this species is found.

9. Ricinocarpos ledifolius F.Muell., *Fragm.* 1: 76 (1859) ('*Ricinocarpus*'); *Roeperia ledifolia* (F.Muell.) Kuntze, *Revis. Gen. Pl.* 2: 618 (1891). **Type:** [Queensland.] Burdekin, *s.d.*, *F.Mueller s.n.* (lecto [here chosen]: MEL 26456; isolecto: K [ex herb. Hook.]).

***Illustration*:** Stanley & Ross (1983: 425, fig. 66c).

Monoecious or dioecious, spreading, open **shrubs or small trees** to 5 m high, shoot apices and flower buds with ferruginous indumentum. Young branchlets terete, with a dense greyish-white indumenutm; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.4 mm across, with stipes < 0.1 mm long. Older branchlets with surface becoming shallowly, longitudinally, reticulately fissured, greyish in colour. **Leaves** petiolate, spirally alternate; petioles 2–5 mm long, densely hairy with hairs as for branchlets; blades linear to narrow-oblong, very narrow-ovate or very narrow-elliptic to narrow-elliptic, (25–) 30–75 (–90) mm long, 3–12 (–15) mm wide, with a length/width ratio of 3–17:1; adaxial surface stellate-pubescent when young but becoming glabrous except for scattered persistent hairs along the midline, smooth; abaxial surface pubescent with soft white stellate hairs up to 0.2 mm across; base cuneate to obtuse; margins recurved; apex acute, obtuse or rounded; midvein impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or occasionally present on blade, up to 3 mm from base, 1 each side of midrib, sessile, smooth, *c.* 0.3 mm across. **Inflorescences** of a single male or female flower, or ± umbelliform with 2 or 3 female flowers, 2–6 male flowers or 2–6 triads with each triad consisting of a central female flower and 2 subtending male flowers, terminal on branchlets; bracts and bracteoles narrow-ovate, 2–8 mm long, ± glabrous adaxially, stellate-pubescent abaxially, caducous. **Flowers** conspicuous; pedicel densely hairy with a mixture of ferruginous and greyish-white stellate hairs; calyx 5-lobed; petals 5 (rarely 6), slightly shorter to slightly longer than calyx; disc a glandular ring. **Male flowers:** pedicel slender, 8–20 mm long; calyx densely pubescent with a mixture of ferruginous and greyish-white stellate hairs abaxially, white stellate-pubescent adaxially, lobes ovate to semi-elliptic, 3–5 mm long, 2.2–4.3 mm wide, acute, obtuse or rounded at the apex; petals ovate or semi-elliptic, 3.5–6 mm long, 2–4 mm wide, white, glabrous, with margins few-notched, obtuse to rounded at the apex; disc 0.2–0.8 mm long, dorsi-ventrally compressed, stellate-hairy adaxially, ± glabrous abaxially, irregularly toothed distally; central column 1.5–2 mm long, tomentose; stamens 40–50; free portion of filaments *c.* 2 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.8 mm long. **Female flowers:** pedicel stout, 7–12 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate to semi-elliptic, 3–4 mm long, 2–3 mm wide, acute to obtuse at the apex; petals ± elliptic, 3.7–4.5 mm long, 1.6–3.7 mm wide, white, glabrous, with margins entire, rounded at the apex, marcescent; disc as for male flowers; ovary subglobose, 3-sulcate, 1.5–1.7 mm long, densely stellate-pubescent; style ± obsolete; stigmatic limbs 1.8–3 mm long, glabrous; lobes spreading to ± upwardly curving, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** depressed ellipsoidal, trilobate, 5–6 mm long, 7–7.5 mm across, stellate-tomentose, usually 3-seeded; calyx *c.* a quarter the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, 4.5–5 mm long (including caruncle), 3–3.2 mm wide, 2.7–2.8 mm deep; testa pale brown; caruncle ± hemispherical, *c.* 0.4 mm long and 1 mm wide, ± smooth, yellowish-white.

***Additional selected specimens* (*from 59 examined*): Queensland.** North Kennedy District: Rishton Scrub, 30 km SE of Charters Towers, Sep 1991, *Thompson*

253 & Dillewaard (BRI); Rochford Scrub, 25 km W of Ravenswood, Sep 1991, *Thompson 222 & Dillewaard* (BRI). South Kennedy District: 6 miles [*c.* 10 km] W of 'Dabin' Station, Jul 1964, *Adams 1089A* (AD, BRI, PERTH); 'Blenheim', Apr 1993, *Fensham 817* (BRI); 'Eaglefield', Oct 1993, *Fensham 1202* (BRI); Lizzie Creek road, off Eungella to Collinsville road, Apr 2000, *Forster PIF25533 & Booth* (BRI). Leichhardt District: W slopes of Gogango Range, *c.* 20 km ESE of Duaringa, Jun 1983, *Anderson 3432* (BRI); *c.* 17 km ESE of Duaringa, Sep 1988, *Anderson 4516* (BRI); 9.9 km W of junction of old inland Highway (Marlborough – Sarina) on Oxford Downs–Sarina road, S of Pine Mt, Aug 1996, *Champion 1382 & Canning* (BRI); Palmgrove N.P., NW of Taroom, Nov 1998, *Forster PIF23810 & Booth* (BRI); Rockhampton–Duaringa road, *c.* 16 km from Duaringa, Aug 1973, *Moriarty 1357* (CANB). Port Curtis District: Wedge Island, Keppel Bay, Nov 1987, *Batianoff 9822 & Dillewaard* (BRI); Peak Island, Keppel Bay, Nov 1987, *Batianoff 9860 & Dillewaard* (BRI); Spring Creek, 5 km NNE of 'Craiglands' Homestead, Sep 1989, *Forster PIF5709 & Bean* (BRI). Burnett District: Old Cannindah, 11 km SE of Monto, Nov 1995, *Bean 9204 & Turpin* (BRI). Wide Bay District: Stony Creek, 4 km E of Didcot, Sep 1988, *Forster PIF4711* (BRI, MEL). Darling Downs District: Freestone area, 5.5 km SW of Gladfield, Nov 1977, *McDonald 2007* (BRI). Moreton District: Burtons Gully, 10 km WSW of Mt Whitestone, Oct 1985, *Forster PIF2252 & Bird* (BRI).

***Distribution and habitat*:** *Ricinocarpos ledifolius* is confined to Queensland from Townsville southward to near Warwick (**Map 10**). It is most commonly recorded as growing on rocky sites in semi-evergreen vine thicket and vine forest communities.

***Phenology*:** Flowers have been collected throughout the year particularly from July to November, fruits in January, April, June and November.

***Affinities*:** *Ricinocarpos ledifolius* is similar to *R. speciosus* Müll.Arg. but differs from that species in having smaller petals and fruits, shorter petioles and generally smaller leaves.

***Typification*:** Mueller (1859) did not cite any particular specimens in his protologue of *Ricinocarpos ledifolius* but made a comment on the distribution and habitat of the species, *viz.* "In virgultis sic dictis Brigalow Scrub Australiae orientalis calidioris" [in scrubs so called brigalow scrub of warm eastern Australia]. We have located four sheets (two at MEL [26456, 26450] and two at K) collected by Mueller from central Queensland when he accompanied A.C.Gregory on the North Australian Exploring Expedition (1855–1857). There appears to be two collections, one labelled "Ricinocarpos (Bertya) ledifolius, Burdekin" and the other labelled "Ricinocarpos (Bertya) ledifolius var. volubilis, Burdekin". These collections are considered to be at least part of the material used by Mueller in describing *R. ledifolius,* as their collection predates Mueller's publication of the name *R. ledifolius*, are labelled in Mueller's hand with the name *Ricinocarpos ledifolius* and agree with the description in the protologue. The sheet MEL26456 is selected here as lectotype and the K sheet labelled "Ricinocarpos (Bertya) ledifolius, Burdekin" is considered to be an isolectotype.

10. Ricinocarpos linearifolius Halford & R.J.F.Hend. **species nova** *R. bowmanii* F.Muell. et *R. trachyphyllo* Halford & R.J.F.Hend. maxime affinis. A *R. bowmanii* foliorum lamina pagina adaxiali levi non scabra et pagina abaxiali sericea non pubescenti et foliis proportione longioribus (folii lamina ratione longitudinis ad latitudinem 20–32:1 non 3–15:1) differt. A *R. trachyphyllo* foliorum lamina pagina adaxiali levi non scabra et indumento implexo tomentoso non villoso in pedicellis et calycum pagina adaxiali differt. Etiam *R. linearifolius* ad *R. gloria-medii* J.H.Willis simulat foliis linearibus et floribus amplitudinis similaris sed foliis petiolo breviore floribus maribus staminibus paucioribus foliorum lamina pagina abaxiali indumento sericeo non tomentoso et plerumque angustiore et pagina adaxiali mox glabra et plus minusve nitida non plerumque sparsim pubescenti stellata et impolita differt. **Typus:** Queensland. Leichhardt District: Blackdown Tableland, near lookout and picnic area beside road at northern end, 16 October 1987, *R.J.F.Henderson H3104* (holo: BRI; iso: CANB, MEL, NSW, K, distribuendi).

Ricinocarpos sp. (Blackdown Tableland R.J.Henderson H610), Forster & Halford (2002: 73; 2007: 72).

***Illustrations*:** Williams (1979: 254) as *R. bowmanii*; Williams (1999: 340) as *R.* aff. *R. bowmanii.*

Monoecious or dioecious **shrubs** to 1 (–2) m high, shoot apices and flower buds with ferruginous indumentum. Young branchlets

terete, with a dense grey-white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.3 mm across, with stipes < 0.1 mm long. Older branchlets shallowly longitudinally fissured, ± dark grey. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 0.8–1.5 mm long, densely hairy with hairs as for branchlets; blades linear, (8–) 15–45 (–50) mm long, 1–1.3 mm wide, with a length/width ratio of 20–32:1; adaxial surface stellate-pubescent when young but soon becoming glabrous and smooth; abaxial surface sericeous with loosely appressed soft stellate hairs, up to 2 mm across; base cuneate or truncate; margins revolute to midrib so that only midrib of abaxial surface of leaf blade is visible; apex obtuse to rounded or acute and usually mucronate with extension from midrib; midvein obscure or slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands present at base blade, 1 per side of midrib, ± sessile or stipitate, smooth, *c.* 0.1 mm across; stipes up to 0.3 mm long. **Inflorescences** of a single male or female flower, or umbelliform with either 2–4 male flowers or one central female flower surrounded by up to 3 male flowers, terminal on branchlets; bracts linear to lanceolate, 3–4 mm long, ± glabrous adaxially, densely stellate-pubescent abaxially, caducous; bracteoles lanceolate, 2–3 mm long, glabrous abaxially, sparsely stellate-pubescent adaxially, readily caducous. **Flowers** conspicuous; pedicel densely hairy with ferruginous stellate hairs; calyx 5-lobed; petals 5, slightly longer than calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 4–15 (–25) mm long; calyx densely tomentose with ferruginous stellate hairs abaxially, white stellate-tomentose adaxially, lobes ovate, 3–4.5 mm long, 1.8–2.7 mm wide, acute at the apex; petals broad-obovate or suborbicular, (5–) 6.2–10 mm long, (3.4–) 4.2–5.5 mm wide, white, glabrous, with margins entire, rounded or acute at the apex; disc-glands 0.5–0.8 mm long, dorsi-ventrally compressed, glabrous except for scattered stellate hairs distally, rounded to truncate at apex; central column (1.7–) 3.5–5.7 mm long, tomentose; stamens 40–50; free portion of filaments 1–1.7 mm long, erect to spreading or decurving at anthesis, glabrous; anthers 0.5–0.8 mm long. **Female flowers:** pedicel stout, 5–20 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate, 4–5 mm long, 2.2–3 mm wide, acute at the apex; petals broad-obovate to obovate, (6.5–) 7.5–9.3 mm long, 3.5–6.2 mm wide, white, glabrous, with margins entire, obtuse to rounded at the apex, marcescent; disc-glands as for male flowers; ovary subglobose, 3-sulcate, 2.2–3.4 mm long, densely stellate-villose; style ± obsolete; stigmatic limbs 1.7–3.5 mm long, glabrous adaxially, scattered stellate hairs proximally abaxially; lobes ± spreading, ± dorsi-ventrally compressed but shallowly grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** subglobose or rarely ovoid, trilobate, 7.5–9.5 (–12) mm long, 8–9.5 mm across, stellate-villose, usually 3-seeded; calyx < half the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, 5.6–6.4 mm long (including caruncle), 3.3–3.8 mm wide, 2.6–3 mm deep; testa dark red-brown; caruncle ± hemispherical, 0.7–0.9 mm long, 1.8–2.1 mm wide, ± smooth, white. **Fig. 5.**

***Additional selected specimens* (*from 72 examined*): Queensland.** Leichhardt District: Salvator Rosa N.P., Sentinel Mountain, Sep 1990, *Ballingall 2651* (BRI); N of Mt Mooloolong, Ka Ka Mundi N.P., via Springsure, May 1999, *Bean 14838* (BRI); 11 km past Glenhaughton on Mapala road, Apr 1992, *Forster PIF9759 & Machin* (BRI, K, MEL); Blackdown Tableland, Sep 1973, *Hanger 128* (BRI); Blackdown Tableland, 32 km SE of Blackwater, Apr 1971, *Henderson H610 et al.* (BRI, MEL, NSW); Blackdown Tableland, 12 miles [*c.* 19 km] SSE of Bluff, Sep 1959, *Johnson 955* (BRI); Blackdown Tableland, Aug 1990, *Jones 6335 & Jones* (CANB); Stony Creek track, Blackdown Tableland, Sep 1974, *Williams 74029* (BRI). Port Curtis District: Kroombit Tops, S.F. 316, Mar 1995, *Thompson BIL171 et al.* (BRI). Burnett District: Eidsvold to Cracow road, 1 km N of Little Morrow Creek crossing, Jan 1992, *Forster PIF9364* (BRI, K, MEL); 9.1 km S of Rawbelle road along powerline access road, Sep 1997, *Thomas & Holland s.n.* (BRI [AQ657979]). Wide Bay District: Mt Walsh summit, Mt Walsh N.P., Aug 1996, *Forster PIF19538 et al.* (BRI). Warrego District: Tickering Creek, Mt Tabor Station, Sep 1991, *Thomas s.n. et al.* (BRI [AQ543527]). Maranoa District: 8 km N of 'Yoothappinna', Sep 1974, *Gittins 2753* (BRI, NSW); The Chimneys, 140 km NW of Injune in Carnarvon N.P., Sep 1997, *Jobson 4949* (BRI); Mt Moffatt N.P., The Tombs area, Sep 1993, *Purdie 4283* (BRI); Carnarvon N.P., Mt Moffatt Section, Sep 1986, *Thomas 76* (BRI). Darling Downs District: 14.1 km ESE of Inglewood, Coolmunda Environmental Park, Oct 1993, *Halford Q1972* (BRI). **New South Wales.** Warialda S.F. 417 north, Nov 1996, *Forster PIF20093* (BRI); Warialda S.F. 417, Dec 1995, *Forster PIF18236* (BRI).

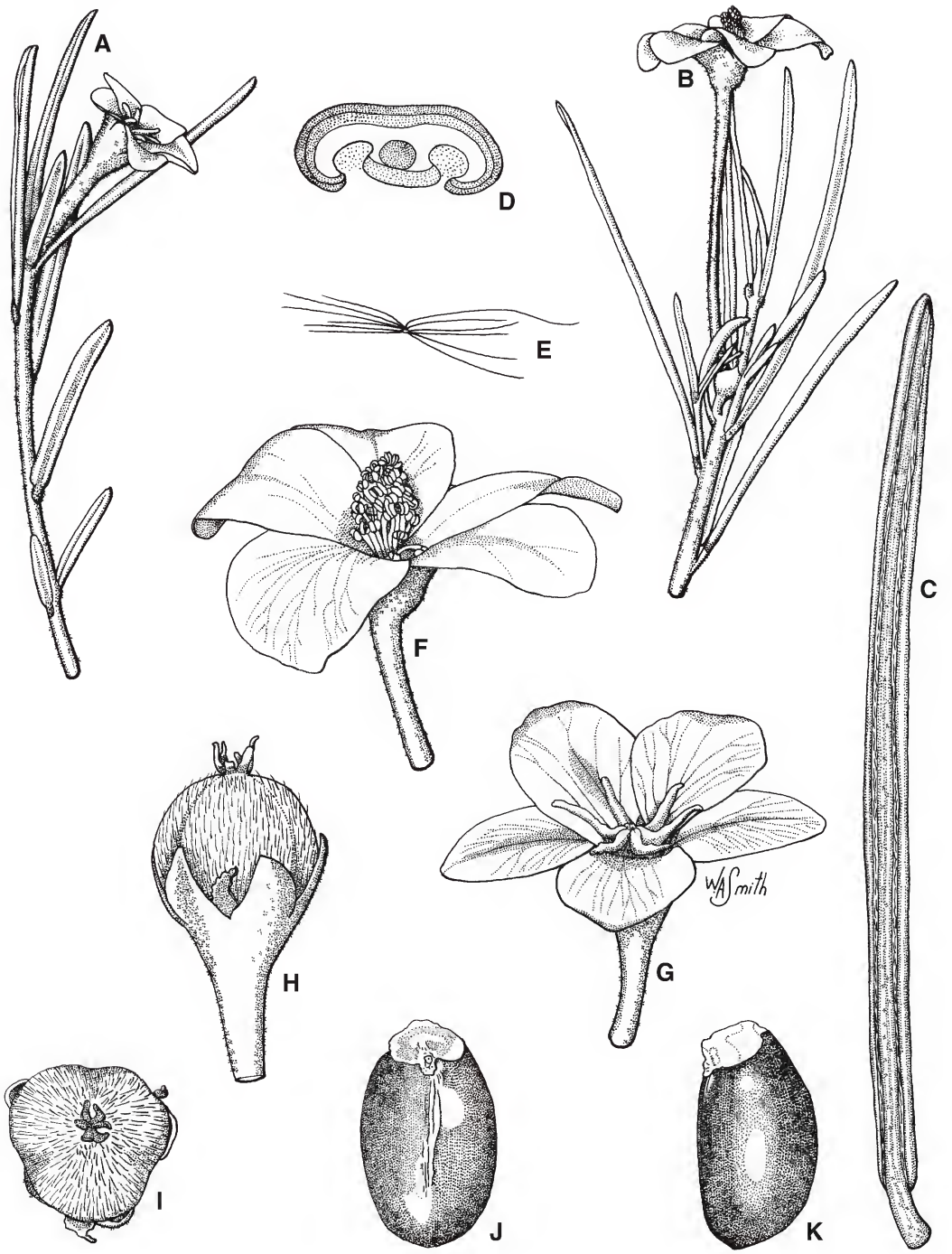


Fig. 5. ***Ricinocarpos linearifolius.*** A. branchlet with female flower × 1.5. B. branchlet with male flower × 1.5. C. adaxial leaf surface × 4. D. transverse section of leaf × 18. E. stellate hair, from abaxial leaf surface × 18. F. side view of male flower × 3. G. side view of female flower × 3. H. side view of fruit × 3. I. face view of fruit × 3. J. ventral view of seed × 6. K. side view of seed × 6. A from *Halford Q8194A & Edginton* (BRI); B–F from *Halford Q8194B & Edginton* (BRI); G from *Henderson H3123* (BRI); H–K from *Henderson H3104* (BRI). Del. W.Smith.

***Distribution and habitat*:** *Ricinocarpos linearifolius* has a disjunct distribution and occurs from near Jericho south-eastwards to Biggenden and near Inglewood in southern Queensland as well as in the Warialda district in northern New South Wales (**Map 11**). It is recorded as growing in heathland, woodland and open forest communities on sandy soils usually associated with sandstone outcrops. It is also recorded as growing on granite and rhyolite substrates.

***Phenology*:** Flowers have been collected throughout the year, but particularly from August to October, fruits in March and from September to December.

***Affinities*:** *Ricinocarpos linearifolius* is most closely allied to *R. bowmanii* and *R. trachyphyllus*. It differs from *R. bowmanii* in its leaf blades with a smooth rather than scabrous adaxial surface and an abaxial surface with a sericeous rather than pubescent indumentum, and in its proportionally longer leaves which have a blade length/width ratio of 20–32:1 compared with 3–15:1 as in *R. bowmanii*. It differs from *R. trachyphyllus* in the smooth rather than scabrous adaxial surface of leaf blades and a matted tomentose rather than shaggy villous indumentum on pedicels and the adaxial surface of the calyces. *Ricinocarpos linearifolius* resembles *R. gloria-medii* in having linear leaves and similar sized flowers, but differs from that in having shorter petioles, fewer stamens in each male flower, a sericeous indumentum on the abaxial surface of the generally narrower leaf blades the adaxial surface of which soon becomes glabrous with a more or less shiny appearance, whereas those of *R. gloria-medii* usually retain a covering of some hairs.

***Etymology*:** The specific epithet is from Latin *linearis* (linear), and *-folius* (leaved), in reference to the shape of leaf blades in this species.

11. Ricinocarpos marginatus Benth., *Fl. Austral.* 6: 73 (1873) (‘*Ricinocarpus*’); *Roeperia marginata* (Benth.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia] York Sound, September 1820, *A.Cunningham 283* (lecto [here chosen]: K; isolecto: BRI, K [ex herb. Benth.], PERTH).

***Illustration*:** Wheeler (1992: 627, fig. 192b).

Monoecious, erect **shrubs** to 3 m high. Young branchlets angular, with a moderately dense white indumentum; hairs stellate, sessile, multiangulate, < 0.8 mm across. Older branchlets terete, with surface becoming striate, pale brown. **Leaves** petiolate, spirally alternate; petioles 1–6 mm long, densely hairy with hairs as for branchlets; blades very narrow-elliptic, 45–90 mm long, 8–20 mm wide, with a length/width ratio of 3–8:1; adaxial surface stellate-puberulous or glabrous except for stellate hairs along the margins and midline; abaxial surface tomentose or pubescent with soft white stellate hairs up to 0.4 mm across; base cuneate; margins ± flat; apex acute; midvein slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure or slightly impressed adaxially, raised abaxially; marginal glands usually present at base of blade, 1 each side of midrib, sessile, smooth, 0.2–0.6 mm across. **Inflorescences** umbelliform with either all male flowers or 1–3 female flowers surrounded by many male flowers, terminal on branchlets but soon appears lateral as it is overtopped by growth of axillary buds; bracts and bracteoles oblong, < 2 mm long, densely stellate-pubescent, caducous. **Flowers** ± inconspicuous; pedicel white stellate-pubescent; calyx 5-lobed; petals 5, slightly shorter than calyx; disc a glandular ring. **Male flowers:** pedicel slender, 3–8 mm long; calyx white stellate-pubescent abaxially and adaxially, lobes ovate to semi-elliptic, *c.* 2.5 mm long, and 2 mm wide, obtuse to rounded at the apex; petals obovate, *c.* 2 mm long, and 2 mm wide, white, glabrous, with margins erose, rounded at the apex; disc 0.4–0.5 mm long, dorsi-ventrally compressed, glabrous, sinuate distally; central column 2.5–3 mm long, tomentose proximally; stamens *c.* 25; free portion of filaments 0.8–1 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel stout, trigonous, 6–15 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes narrow-ovate, 3–4 mm long, 1.2–2 mm wide, acute to obtuse at the apex; petals narrow-oblong, *c.* 3 mm long and 1 mm wide, white, stellate-pubescent abaxially

and adaxially, with margins entire, rounded at the apex, caducous; disc as for male flowers; ovary ovoid, trilobate, *c.* 3 mm long, densely stellate-pubescent; style *c.* 1.5 mm long, stellate-pubescent; stigmatic limbs *c.* 1.2 mm long, glabrous adaxially, stellate-pubescent proximally abaxially; lobes spreading to ± upwardly curving, ± laterally compressed, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, trilobate, 7–8 mm long, 5–6 mm across, stellate-pubescent, usually 3-seeded; calyx *c.* a quarter the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 6 mm long (including caruncle), 3.2 mm wide and 2.8 mm deep; testa pale brown; caruncle ± hemispherical, *c.* 1 mm long and 1.7 mm wide, ± smooth, yellowish-white.

***Additional specimens examined*: Western Australia.** *c.* 10 km S of Swift Bay, off Montague Sound, Jun 1985, *Fryxell 4665 et al.* (CANB, DNA, K, MEL, PERTH); unnamed tributary of the Mitchell River, Dec 1982, *Kenneally 8679* (BRI, PERTH); Amax Survey Pool, Mitchell Plateau, Jun 1971, *Maconochie 1277* (DNA, PERTH); Bigge Island, Jun 2003, *Coate 682* (PERTH).

***Distribution and habitat*:** *Ricinocarpos marginatus* is confined to the Kimberley region of Western Australia where it has been recorded from York Sound, Montague Sound and the Mitchell Plateau (**Map 12**). It is recorded as growing amongst sandstone rocks and in eucalypt woodland on sandstone.

***Phenology*:** Flowers have been collected in June and December, fruits in June.

***Affinities*:** *Ricinocarpos marginatus* is similar to *R. rosmarinifolius* Benth. and *R. trichophyllus*. It differs from *R. rosmarinifolius* in having narrow-elliptic leaves. For features distinguishing *R. marginatus* from *R. trichophyllus*, refer to the 'Affinities' section under that species.

***Typification*:** In the protologue of *Ricinocarpos marginatus*, Bentham (1873) cited a single collection from York Sound, Western Australia, collected by A. Cunningham. Three sheets (one each at BRI, K and PERTH) matching the locality and collector's name have been located. The sheet at K has two specimens on it, one stamped as coming from Herb. Benthamianum and the other from Allan Cunningham's Australian Herbarium. All of this material agrees with the description in the protologue of *R. marginatus*. The latter specimen is selected here as lectotype of the name because it is the more ample of the two collections held at K.

12. Ricinocarpos megalocarpus Halford & R.J.F.Hend. **species nova** *R. tuberculato* Müll. Arg. maxime affinis sed fructibus majoribus (14–16 mm longis et 10–13 mm latis non 10–12 mm longis et 7–8 mm latis) pagina valde tuberculata non laevi ad leniter tuberculatam et foliorum lamina latiore (1.6–1.8 mm lata non 0.8–1.3 mm lata) et proportione breviore (ratione longitudinis ad latitudinem 6–12:1 non 15–20:1) differt. **Typus:** Western Australia. Duke of Orleans Bay, *c.* 64 km E of Esperance, 30 September 1968, *P.G.Wilson 8093* (holo: PERTH; iso: MEL).

Monoecious or apparently sometimes dioecious, compact, rounded **shrubs** up to 2.5 (–4) m high. Young branchlets ± terete, glabrous. Older branchlets with surface becoming shallowly longitudinally fissured, grey. **Leaves** petiolate, spirally alternate; petioles 1.5–2 mm long, glabrous; blades linear, 9–20 mm long, 1.6–1.8 mm wide, with a length/width ratio of 6–12:1; adaxial surface glabrous and smooth; abaxial surface pubescent with white sessile stellate hairs < 0.1 mm across; base cuneate; margins recurved to midrib; apex obtuse to acute, ultimately mucronate with extension from midrib; mucro up to 0.4 mm long, downwardly curved; midvein obscure or slightly impressed adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform with either all male flowers or one female flower surrounded by up to 6 male flowers, terminal on branchlets; bracts and bracteoles, triangular or lanceolate, 3–7 mm long, glabrous, readily caducous. **Flowers** conspicuous; pedicel glabrous; calyx 5-lobed; petals 5 (rarely 6), at least twice as long as calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 8–22 mm long; calyx glabrous adaxially, densely hairy with white crispate hairs adaxially, lobes broad-ovate, 1.3–1.7 mm long, 1.7–1.9 mm wide, obtuse at the apex; petals narrow-obovate, 9.5–11 mm long, 3.5–4.5 mm wide, white, glabrous

except for tuft of hairs proximally on adaxial surface, with margins entire, rounded at the apex; disc-glands 0.3–0.5 mm long, dorsi-ventrally compressed, glabrous, truncate to obtuse at apex; central column 3–3.5 mm long, tomentose; stamens *c.* 55; free portion of filaments 0.3–0.5 mm long, erect at anthesis, glabrous; anthers 0.6–0.8 mm long. **Female flowers:** pedicel stout, 4–15 mm long; calyx caducous, indumentum as for calyx of male flowers, lobes broad-ovate to triangular, 1.5–2.1 mm long, 1.5–1.7 mm wide, obtuse or acute at the apex; petals narrow-obovate, 11–12 mm long, 3.5–4 mm wide, white, glabrous except for tuft of hairs proximally on adaxial surface, with margins entire, rounded at the apex, caducous; disc-glands as for male flowers; ovary ovoid, 2.3–2.5 mm long, glabrous, tuberculate; style ± obsolete; stigmatic limbs of unknown colour when fresh, 1.5–1.8 mm long, glabrous; lobes spreading, ± dorsi-ventrally compressed but shallowly grooved abaxially, verrucose adaxially, ± smooth abaxially. **Fruits** ovoid, trilobate, 14–16 mm long, 10–13 mm across, glabrous, strongly tuberculate, with short acuminate beak, usually 3-seeded. **Seeds** ellipsoid to ovoid, slightly dorsi-ventrally compressed, 8.5–9.5 mm long (including caruncle), 4.1–4.2 mm wide, 3.5–3.8 mm deep; testa pale to light brown with blotches of dark brown; caruncle ± conical, 1.5–2 mm long, 1.2–1.8 mm wide, ± smooth, creamy white. **Fig. 6.**

***Additional selected specimens (from 26 examined)*: Western Australia.** Duke of Orleans Bay, Oct 1970, *Aplin 4248* (PERTH); Esperance, Oct 1965, *Burns 2* (PERTH); Cape Le Grand N.P., between Rossiter Bay car park and the Bird Sanctuary, Sep 1985, *Carter 152* (CANB); Cape Le Grand N.P., Hellfire Bay, Sep 1985, *Corrick 9519* (MEL); Hellfire Bay, Cape Le Grand N.P., Nov 1976, *Demarz D6286* (PERTH); Duke of Orleans Bay, *c.* 63 km E of Esperance, Sep 1968, *Donner 2739* (CANB, PERTH); SE corner of Lucky Bay, Oct 1966, *Filson 9257* (MEL); Cape Le Grand N.P. - Rossiter Bay, Oct 1982, *Forbes 1065* (MEL); Rossiter Bay, Cape Le Grand N.P., Nov 1985, *Foreman 1270* (MEL); Cape Arid, Oct 1960, *Gardner 12951* (PERTH); Whistling Rock in Thistle Cove, Cape Le Grand N.P., Oct 1973, *Garraty 353* (PERTH); Rossiter Bay, Cape Le Grand N.P., Sep 1988, *Henderson H3182* (BRI); Duke of Orleans Bay, opposite Hig Island, Oct 1968, *Orchard 1308* (PERTH); Cape Arid N.P., E of Esperance, Nov 1971, *Royce 9818* (PERTH); Duke of Orleans Bay, Sep 1990, *Short 3895* (MEL); Taylor Boat Harbour, 90 km E of Esperance, Sep 1976, *Story 8273* (CANB, PERTH); Thistle Cove, Cape Le Grand N.P., Nov 1982, *Strid 21223* (PERTH); Mississippi Hill, Cape Le Grand N.P., Aug 1971, *Weston 6781* (PERTH); Lucky Bay, *c.* 35 km ESE of Esperance, Oct 1966, *Wilson 5594* (PERTH).

***Distribution and habitat*:** *Ricinocarpos megalocarpus* is confined to the south coast of Western Australia where it occurs east of Esperance, from Cape Le Grand to Cape Arid (**Map 13**). It is recorded as growing in heath communities on sandy soils on coastal dunes though it has been recorded once on granite (*Demarz D6282* (PERTH)).

***Phenology*:** Flowers have been collected in January, February, June and from August to December, fruits in February and from August to December.

***Affinities*:** *Ricinocarpos megalocarpus* is similar to *R. tuberculatus* but can be distinguished from that species by its larger fruit (14–16 mm long × 10–13 mm across compared with 10–12 mm long × 7–8 mm across), its sculpturing on the fruit surface (strongly tuberculate compared with smooth to weakly tuberculate), and its wider (1.6–1.8 mm wide compared with 0.8–1.3 mm wide) and proportionally shorter leaf blades (with a length/width ratio of 6–12:1 compared with 15–20:1).

***Etymology*:** The specific epithet is derived from Greek *megalo-* (large), and *-carpus* (fruit), and refers to the fruit being larger than those of *R. tuberculatus*, to which it is most similar.

13. Ricinocarpos oliganthus Halford & R.J.F.Hend. **species nova** ad *R. psilocladum* (Müll.Arg.) Benth. maxime affinis sed foliis lamina minore (6–10 mm longa et 0.8–1.3 mm lata non 20–50 mm longa et (1.5–) 2.5–4 mm lata), florum pedicello breviore (3–5 mm longo non 5–16 mm longo) et foliorum lamina pagina adaxiali laevi non tuberculata facile distincta. **Typus:** Western Australia. 1.8 km NE of Canna Siding on Canna North East road, *c.* 38 km NNW of Morawa, 29 June 1996, *B.J.Lepschi BJL2656 & T.R.Lally* (holo: BRI; iso: CANB [and according to a label on the holotype, other isotypes are at AD and PERTH]).

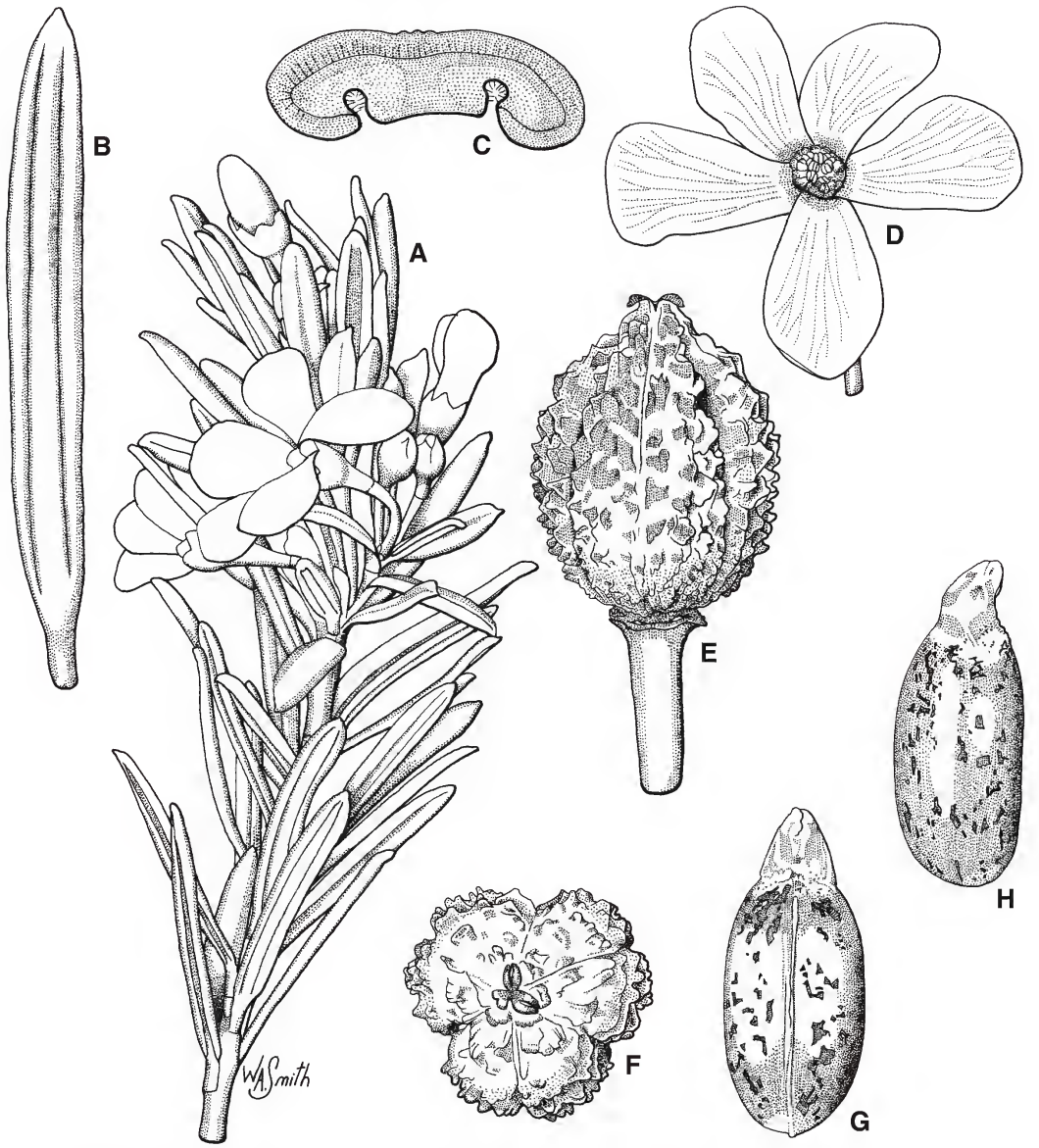


Fig. 6. ***Ricinocarpos megalocarpus.*** A. flowering branchlet × 2. B. adaxial leaf surface × 4. C. transverse section of leaf × 18. D. face view of male flower × 3. E. side view of fruit × 2.5. F. face view of fruit × 2.5. G. ventral view of seed × 4. H. side view of seed × 4. A–H from *Henderson H3182* (BRI). Del. W.Smith.

Monoecious, **shrubs** *c.* 1.8 m high, thinly resinous on most parts. Young branchlets ± angular, glabrous. Older branchlets ± terete, with surface becoming tessellated, ± grey. **Leaves** mostly crowded towards the ends of branchlets, petiolate, spirally alternate; petioles *c.* 1 mm long, glabrous; blades linear to narrow-oblong, 6–10 mm long, 0.8–1.3 mm wide, with a length/width ratio of 7–12:1; adaxial surface glabrous and smooth; abaxial surface puberulous with white stellate hairs < 0.05 mm across; base cuneate; margins revolute to midrib; apex rounded; midvein impressed adaxially, abaxially raised, glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single flower, terminal on branchlets; bracts and bracteoles

± oblong, 1–2 mm long, glabrous, resinous, caducous. **Flowers** conspicuous; pedicel glabrous; calyx 5-lobed; petals 5, slightly longer than calyx; disc a glandular ring. **Male flowers:** pedicel slender, 3–5 mm long; calyx glabrous abaxially and adaxially, resinous abaxially, margins minutely fimbriate, lobes ovate, 3–3.5 mm long, 1.5–2 mm wide, obtuse to acute at the apex; petals narrow-obovate, 7–7.5 mm long, *c.* 2.8 mm wide, white to creamy-white, glabrous, with margins entire, rounded to obtuse at the apex; disc *c.* 0.3 mm long, dorsi-ventrally compressed, glabrous, sinuate; central column *c.* 3 mm long, glabrous; stamens *c.* 45; free portion of filaments *c.* 1 mm long, ± erect at anthesis, glabrous; anthers *c.* 0.6 mm long. **Female flowers:** pedicel stout, 3–4 mm long; calyx persistent, glabrous abaxially and adaxially, resinous abaxially, margins minutely fimbriate, lobes ovate, 3–3.5 mm long, 2–2.4 mm wide, acute at the apex; petals narrow-elliptic, 4–4.2 mm long, 1.5–2.2 mm wide, white to creamy-white, glabrous, with margins entire, rounded at the apex, marcescent; disc as for male flowers; ovary subglobose, 1.3–1.7 mm long, glabrous, ± smooth; style ± obsolete; stigmatic limbs of unknown colour when fresh, *c.* 1.3 mm long, glabrous; lobes spreading, ± dorsi-ventrally compressed but shallowly grooved abaxially, ± smooth on both surfaces. **Fruits** ellipsoid, trilobate, 7.5–8 mm long, *c.* 6 mm across, glabrous, ± smooth, usually 3-seeded; calyx a half or two-thirds the length of mature fruit. **Seeds** not seen.

***Additional specimen examined*: Western Australia.** G.Kowald property, Canna, Aug 2001, *Docherty 107* (PERTH).

***Distribution and habitat*:** *Ricinocarpos oliganthus* is known only from near Morawa, south-western Western Australia (**Map 14**). It is recorded as growing on gravelly, red-brown clay-loam in scrub with mallee eucalypts.

***Phenology*:** Flowers and immature fruits have been collected in June.

***Affinities*:** *Ricinocarpos oliganthus* is similar to *R. psilocladus* but is easily distinguished from that species by its smaller leaf blades (6–10 mm long × 0.8–1.3 mm wide compared with 20–50 mm long × (1.5–) 2.5–4 mm wide), its flowers with a shorter pedicel (3–5 mm long compared with 5–16 mm long) and its leaf blades with a smooth rather than tuberculate adaxial surface.

***Etymology*:** The specific epithet is from Greek, *olig-* (few), and *-anthus* (flowered), and refers to the inflorescences in this species.

14. Ricinocarpos pilifer Halford & R.J.F.Hend. **species nova** *R. glauco* Endl. et *R. undulato* Lehm. maxime affinis sed ab eis speciebus ovario et fructu modice pubescenti non glabro differt. Ab *R. glauco* foliorum lamina pagina abaxiali indumento sericeo non lanato et ab *R. undulato* florum petalis brevioribus (6–8 mm longis non 7–15 mm longis) etiam differt. **Typus:** Western Australia. Mt Le Grand, *c.* 25 km SE of Esperance, 7 October 1966, *P.G.Wilson 5575* (holo: PERTH).

Monoecious, compact **shrubs** up to 0.6 m high. Young branchlets subterete, moderately to densely hairy in two longitudinal bands; hairs simple, erect, up to 0.1 mm long. Older branchlets with surface becoming shallowly, longitudinally fissured and somewhat spongy, greyish-white. **Leaves** petiolate, spirally alternate; petioles 0.5–1.5 mm long, minutely hairy adaxially with appressed to spreading simple hairs, glabrous abaxially; blades narrow-oblong, 10–15 (–20) mm long, 1–1.7 (–2.5) mm wide, with a length/width ratio of 6–9:1; adaxial surface glabrous and smooth; abaxial surface sericeous with loosely appressed ± straight simple hairs, 1.5–2.3 mm long; base cuneate; margins recurved to midrib; apex obtuse to acute, ultimately mucronate with extension from midrib up to 0.3 mm long; midvein obscure adaxially, abaxially raised, glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–4 male flowers or one female flower surrounded by up to 2 male flowers, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet; bracts and bracteoles lanceolate or narrow-ovate, 1.3–3 mm long, sparsely hairy adaxial surface and on margins, glabrous abaxially, caducous. **Flowers** conspicuous;

pedicel glabrous; calyx 5-lobed; petals 5, at least twice as long as calyx in male flowers; disc of 5 discrete glands. **Male flowers** with pedicel slender, 5–13 mm long; calyx glabrous abaxially, sparsely villose with white crispate hairs adaxially, lobes narrow-ovate, 1.8–2.3 mm long, 0.8–1 mm wide, acute at the apex; petals narrow-obovate, 6.2–8 mm long mm long, 1.7–2.1 mm wide, creamy-white, glabrous except for tuft of hairs proximally on adaxial surface, with margins entire, rounded at the apex; disc-glands 0.3–0.5 mm long, dorsi-ventrally compressed, glabrous, truncate to rounded distally; central column 2–2.7 mm long, glabrous; stamens 20–30; free portion of filaments 1–1.3 mm long, ± erect at anthesis, glabrous; anthers 0.4–0.5 mm long. **Female flowers** with pedicel stout, 2–6 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes triangular, 2.5–2.7 mm long, 0.9–1.2 mm wide, acute at the apex; petals not known, readily caducous; disc-glands as for male flowers; ovary ovoid, *c.* 2 mm long, moderately dense to densely hairy with ascending simple hairs *c.* 0.5 mm long; style ± obsolete; stigmatic limbs of unknown colour when fresh, *c.* 1.2 mm long, glabrous; lobes spreading and recurved distally, ± dorsi-ventrally compressed but shallowly grooved abaxially, smooth on both surfaces. **Fruits** ellipsoid, strongly trilobate, *c.* 7 mm long and 4.7 mm across, with a moderately dense indumentum of spreading to ascending simple hairs 0.3–0.5 mm long, usually 3-seeded; calyx *c.* one quarter the length of mature fruit. **Seeds** obloid, *c.* 5.5 mm long (including caruncle), 2.5 mm wide and 2 mm deep; testa pale brown; caruncle ± hemispherical, *c.* 1.5 mm long and 2.5 mm wide, ± smooth, yellowish-white. **Fig. 7.**

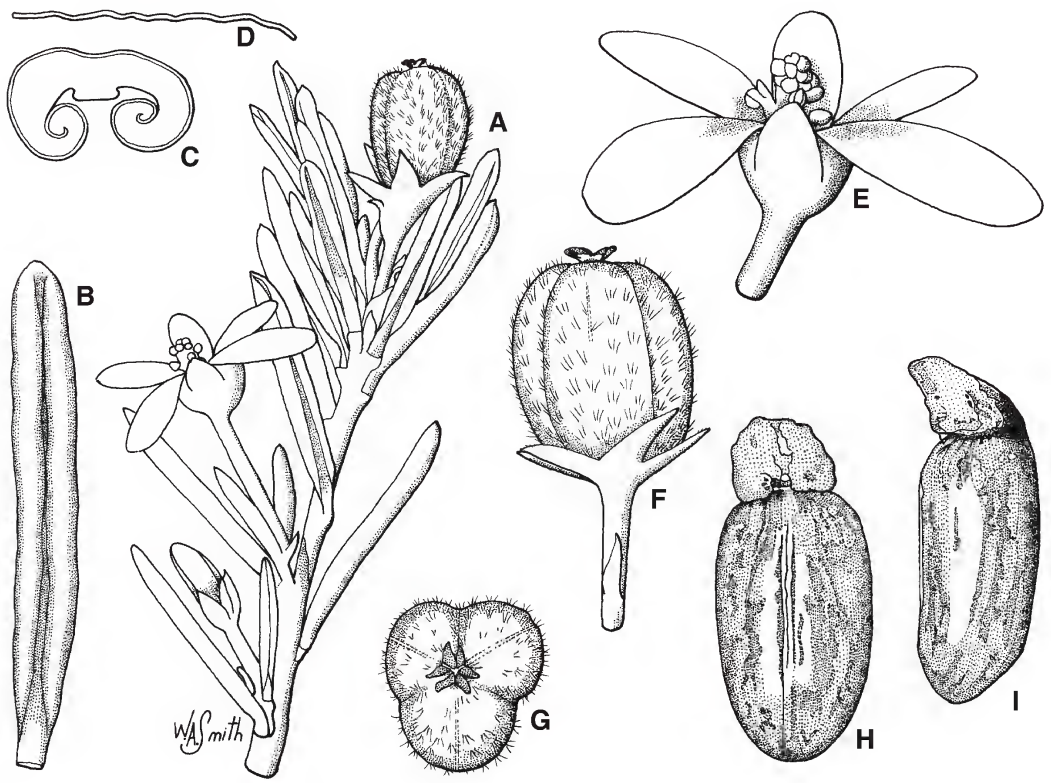


Fig. 7. ***Ricinocarpos pilifer.*** A. flowering and fruiting branchlet × 3. B. adaxial leaf surface × 6. C. transverse section of leaf × 16. D. simple hair, from abaxial leaf surface × 32. E. side view of male flower ×6. F. side view of fruit ×4. G. face view of fruit × 4. H. ventral view of seed × 8. I. side view of seed × 8. A–D, F, G from *Malone 4* (PERTH); E from *Weston 6737* (PERTH); H, I from *Solomon 236* (BRI). Del. W.Smith.

***Additional specimens examined*: Western Australia.** Cape Le Grand, Esperance, Aug 1960, *Malone 4* (PERTH); Cape Le Grand, Oct 1966, *Muir 4274* (MEL); about 400 m W of visitors book, on Thistle Cove–Hellfire Bay trail, Aug 1989, *Solomon 236* (BRI, PERTH); Mt Le Grand, Cape Le Grand N.P., Aug 1971, *Weston 6739* (PERTH); *loc. cit.*, *Weston 6737* (PERTH); *loc. cit.*, *Weston 6738* (PERTH).

***Distribution and habitat*:** *Ricinocarpos pilifer* is confined to southern Western Australia where it is restricted to Mt Le Grand, east of Esperance (**Map 15**). It is recorded as growing in scrub on skeletal soil on granite, on a rocky outcrop near the ocean and on a mountain summit.

***Phenology*:** Flowers have been collected in August and October, fruits in October.

***Affinities*:** *Ricinocarpos pilifer* is similar to *R. glaucus* and *R. undulatus* Lehm. but differs from both of these species by its moderately dense hairy rather than glabrous ovary and fruit. It also differs from *R. glaucus* by its sericeous rather than woolly indumentum on the abaxial surface of the leaf blades and from *R. undulatus* in its flowers with shorter petals (6–8 mm long compared with 7–15 mm long).

***Etymology*:** The specific epithet *pilifer*, Latin for 'bearing hairs', refers to the indumentum-bearing ovary and fruit of this species.

15. Ricinocarpos pinifolius Desf., *Mèm. Mus. Hist. Nat.* 3: 459–461, t. 22 (1817); *Roeperia pinifolia* (Desf.) Spreng., *Syst. Veg.* 16th edn, 3: 147 (1826). **Type:** [New South Wales.] Port Jackson, *s.d.*, [*A. Baudin expedition*] (lecto [here chosen]: P 152766).

Ricinocarpos megalanthus Gand., *Bull. Soc. Bot. France* 66: 287 (1919) (*'Ricinocarpus'*). **Type:** New South Wales. ad Port Jackson, [Sep 1898], *Maiden s.n.* (holo: LY *n.v.*; iso: ?NSW *n.v.*, *fide* McGillivray (1973: 353)).

Ricinocarpos proximus Gand., *Bull. Soc. Bot. France* 66: 287 (1919) (*'Ricinocarpus'*). **Type:** Victoria. [November 1898,] *Walter s.n.* [ex herb. Walter] (holo: LY *n.v.*; iso: ?NSW *n.v.*, *fide* McGillivray (1973: 353)).

Ricinocarpos sidifolius F.Muell. ex Baill., *Étude Euphorb.* 344 (1858), (*'R. sidaefolius'*), *nom. inval.*

***Illustrations*:** Hutchinson (1969: 750, fig. 9); Williams (1979: 254); Costermans (1986: 213); Jeanes (1999: 67, fig. 10d); Jones & Jones (1999: 218); Corrick & Führer (2000: 82).

Monoecious or dioecious, open, erect **shrubs** to 3 m high. Young branchlets ± angular, glabrous. Older branchlets terete, with surface becoming shallowly, longitudinally fissured, ± dark grey. **Leaves** petiolate, spirally alternate; petioles 2–3 mm long, glabrous; blades linear, 10–45 mm long, 0.8–1.6 mm wide, with a length/width ratio of 14–40:1; adaxial surface glabrous, ± smooth; abaxial surface puberulous with soft white stellate hairs up to 0.1 mm across; base cuneate; margins recurved to midrib so that only midrib of abaxial surface of leaf blade is visible; apex acute, ultimately mucronate with extension from midrib; mucro straight, up to 0.6 mm long; midvein slightly impressed adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–6 male flowers or one female flower surrounded by up to 5 male flowers, terminal on branchlets; bracts lanceolate, 3–7 mm long, glabrous, caducous; bracteoles absent. **Flowers** conspicuous; pedicel glabrous; calyx 5-lobed; petals 5 (rarely 6 or 7), up to five times as long as calyx; disc of 5 (rarely 6 or 7) discrete glands. **Male flowers:** pedicel slender, 12–25 mm long; calyx glabrous abaxially, moderately hairy with white crispate hairs adaxially, lobes ± triangular, 1.2–3.7 mm long, 1–2.3 mm wide, acute at the apex; petals narrow-obovate, 7–13 mm long, 2–5 mm wide, white, glabrous except for tuft of simple white hairs proximally on adaxial surface, with margins entire, rounded at the apex; disc-glands 0.3–0.5 mm long, dorsi-ventrally compressed, glabrous, truncate-sinuate distally; central column 4–6 mm long, glabrous; stamens 25–40; free portion of filaments 0.3–0.6 mm long, spreading to erect at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel stout, 3–10 mm long; calyx caducous, indumentum as for calyx of male flowers, lobes triangular, 1.3–2.3 mm long, 1–1.5 mm wide, acute at the apex; petals narrow-obovate, 6–14 mm long, 2.5–5 mm

wide, white, glabrous except for tube of simple white hairs on adaxial surface, with margins entire, rounded at the apex, caducous; disc-glands as for male flowers; ovary ± globose but somewhat trilobate, 2–3.2 mm long, glabrous, ± verrucose; style *c.* 0.3 mm long, glabrous; stigmatic limbs 2.3–3.2 mm long, glabrous; lobes spreading to ± upwardly curving, ± terete but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** globose to depressed globose, trilobate, 8–12 mm long, 10–14 mm across, glabrous, spiculate with subulate processes up to 3 mm long, usually 3-seeded. **Seeds** ovoid, dorsi-ventrally compressed, 5.7–9 mm long (including caruncle), 3.2–4.2 mm wide, 2.9–3.8 mm deep; testa pale reddish-brown and blotched with dark brown; caruncle ± hemispherical, 1–1.5 mm long, 2–2.5 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 311 examined)*: Queensland.** Port Curtis District: 2 km W of Rules Beach, near Baffle Creek, NE of Bundaberg, Oct 1996, *Bean 1090* (BRI); Shoalwater Bay, Freshwater sector, Jun 1999, *Brushe JB1955* (BRI). Wide Bay District: Burrum Coast N.P., Woodgate section, Oct 1996, *Forster PIF19903 & Leiper* (BRI, MEL); 5 km SW of Tinnanbar, Sep 1987, *Halford 1136* (BRI). Moreton District: Tugun, Sep 1930, *Hubbard 3941* (BRI). **New South Wales.** La Perouse, Oct 1975, *Coveny 7253* (NSW); *c.* 13 km WNW of Yalwal on road to Nowra, Oct 1990, *Henderson & Turpin H3427* (BRI); Green Cape, Oct 1961, *Phillips s.n.* (CANB [CBG001617]); Saltwater, near Wallabi Point, Dec 1987, *Dunn 144 & McMahon* (MEL, NSW). **Australian Capital Territory.** Jervis Bay road, near Caves Beach turnoff, Sep 1983, *Howe 55* (BRI). **Victoria.** Allen Head, Genoa River, Bottom Lake, Oct 1991, *Albrecht 4833* (BRI, MEL); *c.* 4 km SE of Dutson Downs, Oct 1986, *Corrick 9987 & Conn* (CANB, MEL); 4 miles [*c.* 6 km] direct line E of Frankston, Sep 1967, *Cullimore 81* (MEL); Holey Plains State Park, Nov 1991, *Fletcher 6* (MEL); Croajingalong N.P., *c.* 4 km direct NW of Mallacoota, near junction of Mallacoota and Korbethong roads, Sep 1994, *Lyne 1479* (CANB). **Tasmania.** 2.5 km N of Coles Bay on Swansea road, Feb 1983, *Forbes 1388* (CANB, HO, MEL); Waterhouse road, Oct 1981, *Morris 8172* (HO, MEL); Bridport, Oct 1981, *Morris 8186* (HO, MEL); Reeves Creek – Picnic Corner, Sep 1983, *Moscal 2683* (HO, MEL); Bay of Fires, Sep 1983, *Moscal 2802* (HO, MEL).

***Distribution and habitat*:** *Ricinocarpos pinifolius* is widespread in coastal and near-coastal areas of eastern Australia from Whitsunday Island, Queensland, to the Otway region, Victoria, and in Tasmania from near Bridport and along the east coast to Coles Bay with one record from Bruny Island (**Map 16**). It is recorded as growing on sandy soils mostly in heath, shrubland, woodland or open forest communities.

***Phenology*:** Flowers have been collected throughout the year particularly from July to November, fruits throughout the year particularly from October to January.

***Affinities*:** *Ricinocarpos pinifolius* is similar to *R. megalocarpus*, *R. ruminatus* Halford & R.J.F.Hend. and *R. tuberculatus*. It differs from *R. megalocarpus* and *R. tuberculatus* by its spiculate fruits. *Ricinocarpos pinifolius* also differs from *R. megalocarpus* in having proportionally narrower leaf blades. For features distinguishing *R. pinifolius* from *R. ruminatus*, refer to the 'Affinities' section under that species.

***Typification*:** Desfontaines (1817), in his protologue of *R. pinifolius*, cited material collected from Port Jackson during the Baudin expedition ("Cet arbrisseau croit spontanément au Port Jackson, d'où les botanistes de l'expédition du capitaine Baudin en ont rapportés des rameaux conservés dans les herbiers du jardin du Roi"). Four sheets of apparently original material have been located amongst material on loan to BRI from P [152763, 152764, 152765, 152766]. All of this material agrees with the description in the protologue of *R. pinifolius*. The sheet numbered 152766 at P is here selected as the lectotype of *R. pinifolius*.

***Notes*:** In regards to the type material of the name *Ricinocarpos megalanthus*, McGillivray (1973: 353) stated that "the original collection from which this material was taken is probably NSW90446, Nepean River, Forsyth 9.1898.". Chapman (1991: 2522) listed the NSW specimen NSW119054 as probable isotype of *R. megalanthus* but this is clearly an error here for he again cited this specimen as a possible isotype of *R. proximus* under that name, which accords more with McGillivray's comments on it.

McGillivray (1973: 353) indicated that the holotype of the name *Ricinocarpos proximus* is the specimen to the right on the LY sheet, the other not belonging to the type collection. He

also stated that NSW119054 is "a good match for the type" but failed to give details relative to it. It thus may or may not be an isotype of *R. proximus*.

16. Ricinocarpos psilocladus (Müll. Arg.) Benth., *Fl. Austral.* 6: 71 (1873) ('*Ricinocarpus*'); *Bertya gummifera* var. *psiloclada* Müll.Arg., *Flora* 47: 471 (1864); *Roeperia psiloclada* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia.] Swan River, *s.d.*, [*J.*] *Drummond n. 153* (holo: K [ex herb. Hook.]).

Bertya psiloclada (Müll.Arg.) Baill., *Adansonia* 6: 299 (1866), *nom. inval.*

Monoecious or dioecious, erect, open **shrubs** to 1.8 m high, resinous on young branchlets, inflorescences and leaves. Young branchlets subterete, sparsely tuberculate, reddish in colour, glabrous. Older branchlets with surface becoming tessellated, ± grey. **Leaves** petiolate, spirally alternate; petioles 1.5–3 mm long, glabrous; blades linear to narrow-oblong or very narrow-obovate, 20–40 mm long, (1.5–) 2.5–7 mm wide, with a length/width ratio of 5–12 (–18):1; adaxial surface glabrous, tuberculate; abaxial surface tomentose with soft white stellate hairs up to 0.4 mm across; base cuneate; margins recurved; apex obtuse to rounded; midvein impressed adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–5 male flowers or one female flower surrounded by up to 3 male flowers, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet; bracts and bracteoles narrow-ovate, 1–2 mm long, glabrous, resinous, caducous. **Flowers** conspicuous; pedicel glabrous, resinous; calyx 5-lobed; petals 5, *c.* twice as long as calyx. **Male flowers:** pedicel slender, 5–16 mm long; calyx glabrous abaxially and adaxially, resinous abaxially, lobes ovate or oblong-ovate, 3–4 mm long, 2–2.5 mm wide, obtuse or rounded at the apex; petals obovate, 6–9 mm long, 3.5–4 mm wide, white, glabrous, with margins entire, obtuse to rounded at the apex; disc of 5 discrete glands; glands 0.3–0.4 mm long, dorsi-ventrally compressed, glabrous, truncate-sinuate distally; central column 2–3 mm long, glabrous; stamens 40–50; free portion of filaments 1–1.6 mm long, erect at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel stout, 6–15 mm long; calyx persistent, enlarging in fruit, glabrous abaxially and adaxially, resinous abaxially, lobes ovate, 3.4–4 mm long in flower (7–9 mm long in fruit), 1.8–2.1 mm wide in flower (5–6.5 mm wide in fruit), acute to obtuse at the apex; petals elliptic or obovate, 7–8.5 mm long, 2.5–4.5 mm wide, white, glabrous, with margins entire, rounded at the apex, marcescent; disc a glandular ring, 0.5–0.6 mm long, dorsi-ventrally compressed, glabrous, truncate distally; ovary ovoid but 3-sulcate, *c.* 1.5 mm long, glabrous, ± smooth; style ± obsolete; stigmatic limbs 1.5–2 mm long, glabrous; lobes spreading to ± upwardly curving, ± terete but grooved abaxially, smooth of both surfaces. **Fruits** ellipsoidal, 5–7 mm long, 6–7 mm across, glabrous, ± smooth, usually 3-seeded; calyx slightly longer than the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, 4.7–5 mm long (including caruncle), 3.2–3.4 mm wide, 2.7–3 mm deep; testa brown t dark brown; caruncle ± reniform, *c.* 0.7 mm long, and 1.7 mm wide, ± smooth, creamy white.

***Additional selected specimens* (*from 28 examined*): Western Australia.** Waggrakine cutting, Jul 1965, *Ashby 1494* (PERTH); Moresby Range, Howatharra, Jun 1966, *Burns 4* (PERTH); Burma road, 23 km N of Irwin River crossing, Jul 1986, *Corrick 9807* (MEL); 16 km S of Northampton, Aug 1985, *Demarz 10675* (PERTH); 32 km N of Geraldton on North West Coastal Highway, Aug 1983, *Dixon s.n.* (PERTH); Geraldton District, Northampton road, Jul 1964, *Galbraith WA116* (MEL); Mt Peron, Aug 1949, *Gardner 9407* (PERTH); 21 miles [*c.* 34 km] N of Geraldton, Sep 1966, *George 7943* (PERTH); *c.* 20 km S of Northampton, on road to Geraldton, Sep 1988, *Henderson H3149* (BRI); 37 km N of Geraldton, Aug 1976, *Hnatiuk 760374* (PERTH); Gardner Range, Coomallo District, Jul 1980, *Lievense s.n.* (PERTH); *c.* 15.4 km S of Northampton along North West Coastal Highway, Aug 1983, *Lynch 30* (PERTH); Howatharra Hill Reserve, Moresby Range, Jun 1974, *McFarland & McFarland 1036* (PERTH); Moresby Flat Top[ped] Range, 10 miles [*c.* 16 km] S of Northampton, Jul 1953, *Melville 4162 & Calaby* (CANB, K, PERTH); 20 miles [*c.* 32 km] N of Geraldton, Aug 1965, *Newbey 2187* (PERTH); 10 miles [*c.* 16 km] S of Northampton, Sep 1966, *Smith 66/401* (CANB, MEL, PERTH); Nanson to Howatharra road, 17 miles [*c.* 27 km] N of Geraldton, Jul 1995, *Smith 1760* (MEL).

***Distribution and habitat*:** *Ricinocarpos psilocladus* is confined to south-western Western Australia in the Geraldton to Northampton area, with one collection of it from Mt Peron near Jurien (**Map 17**). It is recorded as growing mostly on rocky slopes on sandy to loam or gravelly soils in heath or shrubland communities.

***Phenology*:** Flowers have been collected from May to September, fruits in August and September.

***Affinities*:** *Ricinocarpos psilocladus* is similar to *R. graniticus* Halford & R.J.F.Hend. and *R. oliganthus* Halford & R.J.F.Hend. For features distinguishing *R. psilocladus* from these species, refer to the 'Affinities' section under the species concerned.

17. Ricinocarpos rosmarinifolius Benth., *Fl. Austral.* 6: 72/73 (1873); *Roeperia rosmarinifolia* (Benth.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia.] Montague Sound, September 1820, *A.Cunningham 284* (lecto, [here chosen]: K; isolecto: BRI, CANB, K [ex herb. Hook.], MEL 2065959, PERTH).

***Illustration*:** Wheeler (1992: 627, fig. 192c).

Monoecious, erect, slender, open **shrubs** to 2 m high. Young branchlets angular, with a moderately dense white indumentum, glabrescent; hairs stellate, sessile, multiangulate, <1 mm across. Older branchlets terete, with surface becoming striate, pale red-brown. **Leaves** petiolate, spirally alternate; petioles 1–3 mm long, densely hairy with hairs as for branchlets; blades linear or rarely very narrow-ovate, 30–80 (–110) mm long, 1.3–2 (–8) mm wide, with a length/width ratio of 26–40:1; adaxial surface glabrous except for scattered sessile stellate hairs especially along the midline, smooth; abaxial surface pubescent with soft white stellate hairs up to 0.3 mm across; base cuneate; margins recurved; apex acute or obtuse, occasionally ultimately mucronate with extension from midrib up to 0.1 mm long; midvein impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands present on blade, up to 2 mm from base, 1 each side of midrib, sessile, smooth, *c.* 0.1 mm across. **Inflorescences** of a single male or female flower, or ± umbelliform with either 2–4 male flowers or one female flower surrounded by up to 4 male flowers, terminal on branchlets but soon appears lateral as it is overtopped by growth of axillary buds; bracts and bracteoles linear, up to 4 mm long, densely stellate-pubescent adaxially and abaxially, caducous. **Flowers** ± inconspicuous; pedicel white stellate-pubescent; calyx 5-lobed; petals 5, slightly shorter than calyx; disc a glandular ring. **Male flowers:** pedicel slender, *c.* 1 mm long; calyx white stellate-pubescent abaxially and adaxially, lobes ovate to broad-ovate, 1.5–2 mm long, 1.1–1.5 mm wide, rounded at the apex; petals broad-obovate, 1.5–2 mm long, 1–1.5 mm wide, of unknown colour when fresh, glabrous, with margins undulate, rounded at the apex; disc *c.* 0.4 mm long, dorsi-ventrally compressed, glabrous, irregularly lobed distally; central column 2–3 mm long, tomentose proximally; stamens *c.* 20; free portion of filaments 0.4–0.5 mm long, spreading at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel stout, 1.5–4 (–8) mm long; calyx persistent, indumentum as for calyx of male flowers, lobes oblong or triangular, 2–3 mm long, 0.8–1.3 mm wide, rounded at the apex; petals narrow-obovate or narrow-oblong, 1–1.5 mm long, 0.3–0.4 mm wide, of unknown colour when fresh, glabrous, with margins entire or few-notched, obtuse at the apex, caducous; disc as for male flowers; ovary ovoid, *c.* 1.5 mm long, densely stellate-pubescent; style 0.4–1 mm long, stellate-pubescent; stigmatic limbs 0.7–0.9 mm long, glabrous adaxially, stellate-pubescent proximally abaxially; lobes spreading to ± downwardly curving, ± terete, smooth on both surfaces. **Fruits** ellipsoidal, trilobate, 7.5–9 mm long, 5.5–6.8 mm across, sparsely stellate-pubescent with hairs up 0.3 mm across, usually 3-seeded; calyx ± a quarter the length of mature fruit. **Seeds** ellipsoidal, dorsi-ventrally compressed, 5.7–6.7 mm long (including caruncle), 2.9–3.8 mm wide, 2.4–2.8 mm deep; testa pale to dark brown; caruncle ± hemispherical, *c.* 1 mm long, 1.7–2.3 mm wide, ± smooth, yellowish-white.

***Additional specimens examined*: Western Australia.** Mitchell River, Feb 1980, *Dunlop 5236* (CANB, DNA, PERTH); peninsula NE of Frederick harbor at mouth of Hunter River, Jun 1985, *Fryxell 4883 et al.* (CANB); near Gariyeli Creek, Prince Regent River Reserve, Aug 1974, *George 12589* (CANB, PERTH); 1 km E of Mitchell Falls, May 1992, *Halford Q1428* (BRI, PERTH); 4.2 km SW of Anderdon, Jun 1987, *Kenneally 10406 & Hyland* (CANB, PERTH); Mitchell Falls, Mitchell Plateau, Jun 1976, *Kenneally 5007* (PERTH); *c.* 1 km E of Mitchell Falls, Mar 1994, *Mitchell 3372* (BRI, PERTH).

***Distribution and habitat*:** *Ricinocarpos rosmarinifolius* is confined to the Kimberley region of Western Australia where it occurs from the Mitchell Plateau to the Prince Regent River area (**Map 18**). It is recorded as growing on sandy soil amongst sandstone boulders with *Triodia* sp. in open woodland.

***Phenology*:** Flowers have been collected in February, May, June and August, fruits in March, May and June.

***Affinities*:** *Ricinocarpos rosmarinifolius* is similar to *R. marginatus* and *R. trichophyllus*. It differs from *R. marginatus* in having linear or very narrow-ovate leaves. For features distinguishing *R. rosmarinifolius* from *R. trichophyllus*, refer to the 'Affinities' section under the latter species.

***Typification*:** Bentham (1873) cited two collections in the protologue of *R. rosmarinifolius*, namely "Montague and York Sounds, N.W. coast, A. Cunningham". We have been unable to locate the collection from York Sound, but have located six sheets (two at K and one each at BRI, CANB, MEL and PERTH) of the *Cunningham* material from Montague Sound. All this material is believed to have been at Bentham's disposal when he described *R. rosmarinifolius*. The Kew sheet labelled "Monotague Sound, 284/1820 Sept, N.W. Australia, A.Cunningham" is here selected as lectotype of Bentham's name as it is of ample proportions and agrees with his protologue.

18. Ricinocarpos ruminatus Halford & R.J.F.Hend. **species nova** ad *R. pinifolium* Desf. maxime affinis sed fructibus majoribus (14–16 mm longis × 14–16 mm latis non 8–12 mm longis × 10–14 mm latis) et seminibus majoribus (9.5–10 mm longis × 6–6.5 mm latis non 5.7–9 mm longis × 3.2–4.2 mm latis) ellipsoidalibus non ovoideis caruncula ruminata non plus minusve laevi facile distincta. **Typus:** Queensland. Leichhardt District: Planet Downs, E of Rolleston, 16 October 1998, *A.R.Bean 14223* (holo: BRI).

Ricinocarpos sp. (Planet Downs A.R.Bean 14223), Forster & Halford (2002: 73; 2007: 72).

Monoecious, erect **shrubs** up to 2 m high. Young branchlets ± terete, glabrous. Older branchlets terete, with surface becoming longitudinally fissured, ± dark grey. **Leaves** petiolate, spirally alternate; petioles 1.5–2 mm long, glabrous; blades linear, 20–35 mm long, 0.7–1.3 mm wide, with a length/width ratio of 20–40:1; adaxial surface glabrous and smooth; abaxial surface puberulous with white stellate hairs up to 0.2 mm across; base cuneate; margins revolute to midrib; apex acute, ultimately mucronulate with excurrent midrib; mucro recurved; midvein obscure or slightly impressed adaxially, abaxially raised, glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** ± umbelliform with either 2–5 male flowers or one central female flower surrounded by up to 4 male flowers, terminal on branchlets; bracts caducous, not seen. **Flowers** conspicuous, pedicel glabrous; calyx 5(rarely 4)-lobed; petals 5(rarely 4), at least twice as long as calyx. **Male flowers** with pedicel slender, 12–40 mm long; calyx glabrous abaxially, moderately hairy with white crispate hairs adaxially, lobes ovate to broad-ovate, 1.3–1.8 mm long, 1.7–2 mm wide, obtuse at the apex; petals narrow-obovate, 10–13 mm long, 3–3.7 mm wide, white, glabrous except for tuft of hairs proximally on adaxial surface, margins entire, with apex rounded; disc of 5 discrete glands; glands *c.* 0.3 mm long, dorsi-ventrally compressed, glabrous, truncate to obtuse distally; central column *c.* 5 mm long, glabrous; stamens 20–30; free portion of filaments 0.8–2 mm long, ± erect at anthesis; anthers 0.6–0.8 mm long. **Female flowers** not seen; pedicel 10–15 mm long in fruit. **Fruits** subglobose, trilobate, 14–16 mm long, 14–16 mm across, glabrous, ± spiculate with subulate processes 2–4 mm long, very shortly beaked, usually 3-seeded. **Seeds**

ellipsoid, slightly compressed dorsally, 9.5–10 mm long (including caruncle), 6–6.5 mm wide, 5.8–6 mm deep, carunculate; testa pale to light brown with blotches of red-brown; caruncle somewhat obliquely conical, *c.* 1.5 mm long and 4 mm wide, ruminate, ± white. **Fig. 8.**

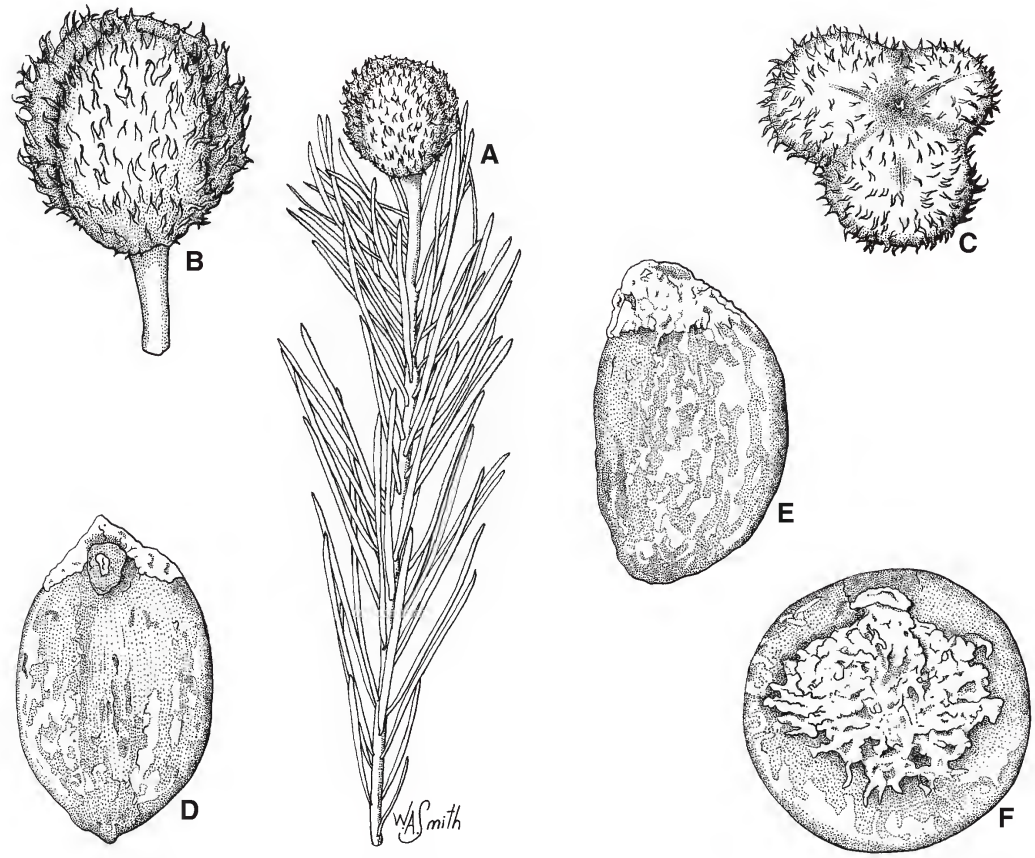


Fig. 8. ***Ricinocarpos ruminatus.*** A. fruiting branchlet × 1. B. side view of fruit × 2. C. face view of fruit × 2. D. ventral view of seed × 4. E. side view of seed × 4. F. face view of caruncle × 6. A–F from *Bean 14223* (BRI). Del. W.Smith.

***Additional specimens examined*: Queensland.** Leichhardt District: Planet Downs, Expedition Range E of Planet Creek, Oct 1999, *Halford Q3837* (BRI); Planet Downs, Nov 1984, *Kerswell 2* (BRI); Expedition Range, Planet Downs lease, *c.* 800m from Planet Creek, Aug 1999, *Schmeider MS153 & Appelman* (BRI); mid way up Planet Creek, 'Planet Downs', Sep 1981, *Walsh s.n.* (BRI [AQ349537]).

***Distribution and habitat*:** *Ricinocarpos ruminatus* is confined to central Queensland where it is known only from the Expedition Range, approximately 45 km east of Rolleston (**Map 19**). It is recorded as growing in open forest on sandy flats and in heathland on skeletal soil on rocky sandstone pavements and on hill tops.

***Phenology*:** Flowers have been collected in August and December, fruits in May and September.

***Affinities*:** *Ricinocarpos ruminatus* is similar to *R. pinifolius* but is easily distinguished from that species by its larger fruits (14–16 mm long × 14–16 mm across compared with 8–12 mm long × 10–14 mm across) with larger seeds (9.5–10 mm long × 6–6.5 mm across compared with 5.7–9 mm long × 3.2–4.2 mm across) that are ellipsoidal rather than ovoid and which have a ruminate rather than more or less smooth caruncle.

***Etymology*:** The specific epithet is from Latin *ruminatus* (penetrated by irregular channels giving an eroded appearance), in reference to the texture of the caruncle on seeds of this species.

19. Ricinocarpos speciosus Müll.Arg., *Flora* 47: 470 (1864) (*'Ricinocarpus'*); *Roeperia speciosa* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [New South Wales.] Wilson River, Port Macquarie, in 1835, [*J.*] *Backhouse s.n.* (holo: K [herb. ex Hook.]).

***Illustration*:** Elliot & Jones (2002: 238).

Monoecious or dioecious, slender, erect, open **shrubs** to 3 m high**;** shoot apices and flower buds with a ferruginous indumentum. Young branchlets terete, with a dense greyish-white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.8 mm across, with stipes < 0.3 mm long. Older branchlets with surface becoming longitudinally ridged, greyish in colour. **Leaves** petiolate, spirally alternate; petioles 4–10 mm long, densely hairy with hairs as for branchlets; blades narrow-elliptic or narrow-oblong, (40–) 50–90 (–120) mm long, 8–20 (–30) mm wide, with a length/width ratio of 4–8:1; adaxial surface stellate-pubescent when young but becoming glabrous except for scattered persistent hairs along the midline, smooth; abaxial surface tomentose with soft white stellate hairs up to 1 mm across; base cuneate to obtuse; margins slightly recurved; apex acute or obtuse; midvein impressed adaxially, abaxially raised and stellate-pubescent or glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent or occasionally present on blade, up to 3 mm from base, 1 each side of midrib, sessile or shortly stipitate, smooth, *c.* 0.1 mm across; stipes < 0.1 mm long. **Inflorescences** ± umbelliform with either 2–4 male flowers or 1–3 female flowers surrounded by up to 4 male flowers, terminal on branchlets; bracts and bracteoles linear, 3–6 mm long, glabrous or stellate-pubescent adaxially, stellate-pubescent abaxially, caducous. **Flowers** conspicuous; pedicel densely hairy with ferruginous stellate hairs; calyx 5-lobed; petals 5, *c.* twice as long as calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 10–25 mm long; calyx densely tomentose with ferruginous stellate hairs abaxially, densely pubescent to tomentose with white stellate hairs adaxially, lobes ovate to semi-elliptic, 3.5–5 mm long, 2–3.5 mm wide, acute, obtuse or rounded at the apex; petals ovate or obovate, 7–9.5 mm long, 3–5.5 mm wide, white, glabrous, with margins few-notched, obtuse to rounded at the apex; disc-glands 0.4–0.7 mm long, dorsi-ventrally compressed, stellate-pubescent abaxially, glabrous adaxially, truncate-sinuate distally; central column 2.5–4 mm long, tomentose; stamens 40–50; free portion of filaments 1–2.5 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel stout, 8–22 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate, 4.5–6 mm long, *c.* 3 mm wide, acute at the apex; petals obovate, *c.* 9.5 mm long and 5 mm wide, white, glabrous, with margins entire, rounded at the apex, marcescent; disc-glands as for male flowers; ovary ovoid but 3-sulcate,*c.* 3.5 mm long, stellate-villose with reddish-brown hairs; style ± obsolete; stigmatic limbs 2.5–3.5 mm long, glabrous; lobes spreading to erect, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, trilobate, 7–11 mm long, 8–11 mm across, stellate-tomentose, usually 3-seeded; calyx a quarter to half the length of mature fruit. **Seeds** ovoid or ellipsoid, dorsi-ventrally compressed, 5.5–5.8 mm long (including caruncle), 3–3.3 mm wide, 2.3–2.8 mm deep; testa brown; caruncle ± hemispherical, *c.* 1 mm long and 1.6 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 41 examined)*:** **Queensland.** Wide Bay District: S.F. 959, Tewantin S.F., 300 m N of Gumboil road, Oct 1997, *Halford Q3422 & Sharpe* (BRI, MEL); S.F. 997, Ringtail L.A., E of Pomona off Boreen–Tewantin road, Aug 1999, *Wang 2052* (BRI). Moreton District: near Mons School road, Buderim, Aug 1995, *Bean 8800* (BRI); 1.2 km along Carricks road, Springbrook, Oct 1997, *Bean 12488* (MEL); Rocky Creek, Mt Barney N.P., Jul 1994, *Bean 7761 & Halford* (BRI); Mt Ballow, Macpherson Range, Jul 1937, *Blake 13083* (BRI); Mt Mee S.F., Aug 1983, *Conran s.n.* (BRI [AQ478366]); Springbrook, Oct 1996, *Forster PIF19826 & Leiper* (BRI, MEL); Mt Barney N.P., 200 m above Upper Portals, Jun 1989, *Halford Q147A* (BRI); Bull L.A., Mt Mee S.F., Sep 1989, *Henderson H3229 & Guymer* (BRI); between Palmwoods and Landsborough, Jul 1930, *Hubbard 3415* (BRI, MEL);

Wilson road, Tanawah, Aug 1996, *Moran s.n.* (BRI [AQ750044]); Springbrook, near Wunburra Lookout on Advancetown–Springbrook road, Jul 1971, *Moriarty 732* (CANB); Mt Mee S.F., 2 km NW of Forestry Station, Jul 1990, *Sked s.n.* (BRI [AQ504252]); Mt Edwards, Sep 1933, *Smith s.n.* (BRI [AQ205253]); Mt Ballow, Jul 1937, *White 11097* (BRI). **New South Wales.** Orara S.F., 7 km SW of Nana Glen, Oct 1990, *Bean 2464* (BRI); near Jirrah road crossing of Coldwater Creek, Bagawa S.F., *c.* 20 km NW of Coffs Harbour, Sep 1997, *Gilmour 7848* (BRI); near the Dandahra Needles, Gibraltar Range, 68 km NE of Glen Innes via Gwydir Highway, Aug 1987, *Hind 5248 & D'Aubert* (BRI); Gibraltar Range, Dandahra Creek–Needles track, *c.* 2.5 km from camping area, Oct 1984, *Telford 9872 & Crisp* (CANB, MEL).

***Distribution and habitat*:** *Ricinocarpos speciosus* occurs in south-eastern Queensland from Tewantin to Springbrook and in north-eastern New South Wales from the Gibraltar Range to the Port Macquarie area (**Map 20**). It is recorded as growing on slopes or on rocky creek banks mostly in wet sclerophyll forest often near rainforest margins.

***Phenology*:** Flowers have been collected from June to October, fruits in September and October.

***Affinities*:** *Ricinocarpos speciosus* is similar to *R. ledifolius* but differs from that species in having flowers with larger petals, larger fruits and generally larger leaves with longer petioles.

20. Ricinocarpos trachyphyllus Halford & R.J.F.Hend. **species nova** *R. bowmanii* F.Muell. et *R. linearifolio* Halford & R.J.F.Hend. maxime affinis. Ab illo foliorum lamina pagina abaxiali sericea non pubescenti et foliis plerumque proportione longioribus (folii lamina ratione longitudinis ad latitudinem 11–30 (–50):1 non 3–15:1) facile distincta. Ab hoc foliorum lamina pagina adaxiale scabra non levi et indumento villoso non tomentoso in pedicellis et calycum pagina adaxiali differt. **Typus:** Queensland. Maranoa District: 21.1 km W of 'Eulorel', W of Surat, 20 August 2001, *A.R.Bean 17746* (holo: BRI; iso: MEL, NSW, distribuendi).

Ricinocarpos sp. (Westmar T.J.McDonald 263), Forster & Halford (2002: 73; 2007: 72).

Monoecious or apparently dioecious **shrubs** to 2 m high. Young branchlets terete, with a dense greyish-white indumentum; hairs stellate, ± sessile, multiangulate, < 0.4 mm across. Older branchlets shallowly longitudinally fissured, ± grey. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 1–1.5 mm long, densely hairy with hairs as for branchlets; blades linear, 15–45 mm long, 0.9–1.2 mm wide, with a length/width ratio of 11–30 (–50):1; adaxial surface stellate-pubescent but becoming scabrid by the persistent tuberculate bases of deciduous hairs; abaxial surface sericeous with loosely appressed soft stellate hairs, up to 2 mm across; base cuneate or truncate; margins revolute to midrib; apex obtuse to rounded and gland-tipped; midvein obscure adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands present on blade, up to 1 mm from base, 1 per side of midrib, ± sessile or stipitate, smooth, *c.* 0.1 mm across; stipes up to 0.1 mm long. **Inflorescences** of a single male or female flower, or umbelliform with either 3 male flowers or one female flower surrounded by up to 3 male flowers, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet; bracts and bracteoles ovate to lanceolate, 3–8 mm long, glabrous adaxially, stellate-pubescent abaxially, caducous. **Flowers** conspicuous; pedicel shaggy villose with ferruginous stellate hairs; calyx 5-lobed; petals 5, slightly longer than calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 8–20 mm long; calyx shaggy villose with ferruginous stellate hair abaxially, white stellate-tomentose adaxially, lobes ovate, 4.5–5.5 mm long, 2.8–3.6 mm wide, acute at the apex; petals obovate, 7–12 mm long, 4.8–5.3 mm wide, white, glabrous, with margins entire, rounded or acute at the apex; disc-glands 0.5–0.8 mm long, dorsi-ventrally compressed, glabrous, rounded to truncate distally; central column 4–5 mm long, tomentose; stamens 30–50; free portion of filaments 1.8–2.5 mm long, erect to spreading or decurving at anthesis, glabrous; anthers 0.6–0.8 mm long. **Female flowers:** pedicel stout, 5–8 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate, 5–6 mm long, 2.8–4 mm wide, acute at the apex; petals broad-obovate to obovate, 8–9 mm long, 5.5–6.5 mm wide, white, glabrous, with margins entire, obtuse

to rounded at the apex, marcescent; disc-glands as for male flowers; ovary subglobose, 3-sulcate, 3.5–4.2 mm long, densely stellate-villose; style ± obsolete; stigmatic limbs 2.8–4 mm long, glabrous adaxially, scattered stellate hairs proximally abaxially; lobes ± spreading, ± dorsi-ventrally compressed but shallowly grooved abaxially, verrucose adaxially, ± smooth abaxially. **Fruits** subglobose or rarely ovoid, trilobate, 8–8.3 mm long, 8–9 mm across, stellate-villose, usually 3-seeded; calyx < half the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 6.7 mm long (including caruncle), 3.6 mm wide and 2.7 mm deep; testa dark red-brown; caruncle ± hemispherical, *c.* 0.8 mm long and 1.2 mm wide, ± smooth, white. **Fig. 9.**

***Additional selected specimens (from 34 examined)*: Queensland.** Warrego District: 64 km SE of Charleville, Aug 1973, *Trapnell 267 & Williams* (BRI). Maranoa District: Thrushton N.P., Jul 1996, *Eddie 15* (BRI); 44 miles [*c.* 70 km] SSE of Charleville, Aug 1963, *Everist 7506* (BRI, MEL); *c.* 44 miles [*c.*70 km] NE of St George, Aug 1956, *Everist 5830* (BRI); Boatman Station, Oct 1957, *Everist 5865* (BRI); Megine to Brucedale road *c.* 40 km due S of Roma, Sep 1995, *Grimshaw PG2177 & Bean* (BRI); 101 km from Charleville on road to Bollon via Boatman, Aug 1979, *McKenzie CT9* (BRI); 28 miles [*c.* 45 km] S of Roma, Sep 1967, *Pedley 2408* (BRI, MEL); 8 km SE of 'Calabah', Jun 1976, *Purdie 472D* (BRI); 75 km SE of Charleville, Sep 1983, *Silcock S653* (BRI). Darling Downs District: Moonie Highway, 16 miles [*c.* 26 km] from Westmar, Sep 1964, *Shoobridge s.n.* (CANB [CBG014317]); 22 km W of Westmar, Moonie Highway, Sep 1966, *McDonald 263* (BRI); 5 miles [*c.* 8 km] W of Westmar on Moonie Highway, Sep 1967, *McDonald 354* (BRI, NSW); 20 miles [*c.* 32 km] W of Westmar on Moonie Highway, Nov 1958, *Pedley 245A* (BRI); 23.6 km W of Westmar, Sep 1988, *Richardson 287 & Meredith* (BRI). **New South Wales.** Yathong Nature Reserve, 45 km N of Roto, Sep 1977, *Brickhill 603-10* (NSW); 'Kiaora', 75 km SW of Cobar, Sep 1978, *Green s.n.* (NSW); 'Buckambool', S of Cobar, Sep 1970, *Keane s.n.* (NSW); Matakana Bore, *c.* 1.5 km S of Matakana, Nov 1973, *Milthorpe & Cunningham 1305B* (NSW); 30 km E of Paddington, Aug 1974, *Pickhard s.n.* (NSW 464888); 'Bloomfield', track along southern boundary, Nov 1987, *Wilson 178 & Wilson* (BRI, NSW).

***Distribution and habitat*:** *Ricinocarpos trachyphyllus* has a disjunct distribution. In southern Queensland, it occurs from Charleville eastwards to Westmar, near St George, and in western New South Wales from near Cobar southward to Matakana (near Lake Cargelligo) (**Map 21**). It is recorded as growing in open ironbark woodland or forest, mallee, and mulga and spinifex communities, on red sandy or sandy clay soils.

***Phenology*:** Flowers have been collected in March and from June to November, fruits from September to November.

***Affinities*:** *Ricinocarpos trachyphyllus* is similar to *R. bowmanii* and *R. linearifolius*. It is easily distinguished from *R. bowmanii* by its sericeous rather than pubescent indumentum on the abaxial surface of the leaf blades and its proportionally longer leaves (leaf blade length/width ratio of 11–30 (–50):1 compared with 3–15:1). It differs from *R. linearifolius* by its scabrous rather than smooth upper leaf blade surface and a shaggy villose rather than tomentose indumentum on pedicels and the adaxial surface of the calyces.

***Etymology*:** The specific epithet is from Greek *trachys* (rough), and *-phyllus*, (leaved), and refers to the scabrid upper (adaxial) surface of leaf blades of this species.

21. Ricinocarpos trichophorus Müll.Arg., *Linnaea* 34: 60/61 (1865) ('*Ricinocarpus*'); *Roeperia trichophora* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia] ad Swan River, *s.d.*, *J.Drummond ser. 4 n.219* (holo: ?G-BOISS *n.v.*; iso: K [two sheets one each ex herb. Benth. and herb. Hook.]).

***Illustration*:** Hopper *et al.* (1990: 76).

Monoecious, erect **shrubs** to 1.8 m high, shoot apices and flower buds with ferruginous indumentum. Young branchlets terete, with a dense grey-white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 1 mm across, with stipes < 0.2 mm long. Older branchlets with surface becoming ridged longitudinally, reddish-brown. **Leaves** sessile or shortly petiolate; spirally alternate; petioles up to 1 mm long, densely hairy with hairs as for branchlets; blades linear to narrow-oblong or rarely very narrow-ovate, 25–60 (–100) mm long, 1.5–4.5 (–10) mm wide, with a length/width ratio of 8–25 (–37):1; adaxial surface stellate-pubescent when young soon becoming glabrous and sparsely tuberculate with persistent bases of deciduous hairs; abaxial surface tomentose with soft white stellate hairs up to 1.7 mm across; base cuneate to obtuse; margins recurved usually so that only midrib of abaxial surface of leaf blade is visible; apex acute or obtuse, sometimes

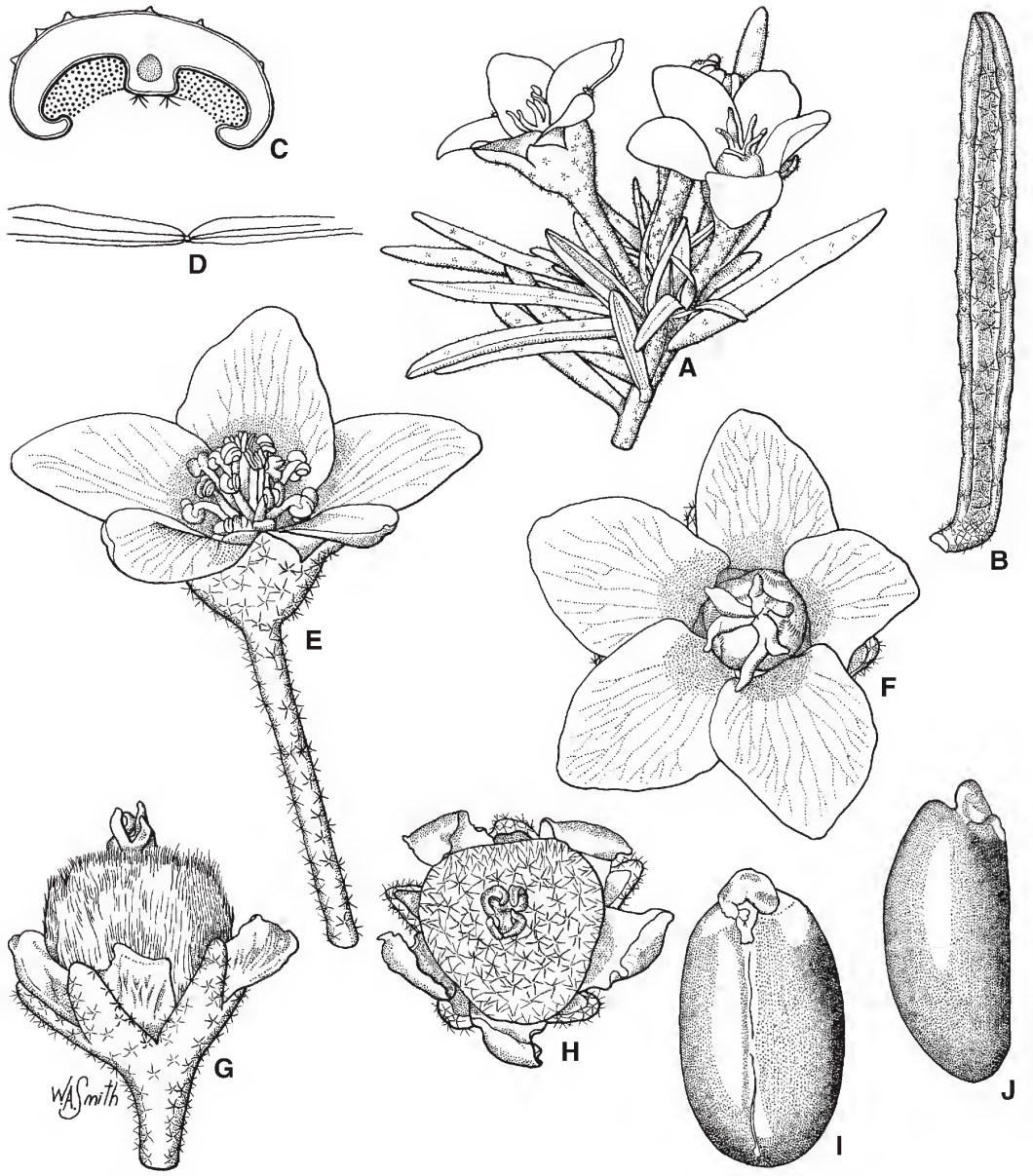


Fig. 9. ***Ricinocarpos trachyphyllus.*** A. flowering branchlet × 2. B. adaxial leaf surface showing indumentum × 4. C. transverse section of leaf × 18. D. stellate hair, from abaxial leaf surface × 18. E. side view of male flower × 4. F. face view of female flower × 4. G. side view of fruit × 3. H. face view of fruit × 3. I. ventral view of seed × 6. J. side view of seed × 6. A–D, F–H from *Halford Q8585A & Thomas* (BRI); E from *Halford Q8585B & Thomas* (BRI); I, J from *Milthorpe 1305B & Cunningham* (NSW). Del. W.Smith.

with sessile gland at tip; midvein impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or present on blade, up to 30 mm from base, 1 or 2 each side of midrib, sessile or stipitate, smooth, *c.* 0.3 mm across; stipes up to 0.4 mm long. **Inflorescences** racemose with one or two female flowers basal on the axis with up to 5 male flowers distal to them, terminal on branchlets, frondobracteose; rachis 2–4 cm long; bracts lanceolate, 4–9 mm long, densely

stellate-pubescent adaxially and abaxially. **Flowers** conspicuous; pedicel densely hairy with ferruginous stellate hairs; calyx 5-lobed; petals 5, *c.* twice as long as calyx. **Male flowers:** pedicel slender, 5–10 mm long; calyx densely tomentose with ferruginous and white stellate hairs abaxially, densely tomentose adaxially with white stellate hairs, lobes narrow-ovate, 4–5.5 mm long, 1.5–2.5 mm wide, acute to shortly acuminate at the apex; petals broad-ovate to obovate, 8–10 mm long, 3.5–5 mm wide, white, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins undulate, rounded at the apex; disc of 5 discrete glands; glands 0.4–0.6 mm long, dorsi-ventrally compressed, glabrous, sometimes irregularly lobed, rounded to truncate distally; central column 3–4.5 mm long, tomentose; stamens 50–60; free portion of filaments 1–1.5 mm long, erect to spreading at anthesis, glabrous or with scattered hairs; anthers *c.* 0.5 mm long. **Female flowers:** pedicel stout, 4–10 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes ovate, 4–7 mm long, 1.5–2.5 mm wide, acute to acuminate at the apex; petals narrow-obovate, 8–9 mm long, 1.5–2.5 mm wide, white, sparsely stellate-pubescent proximally abaxially, stellate-tomentose for most of its length adaxially, with margins entire, obtuse at the apex, marcescent; disc a glandular ring, *c.* 0.2 mm long, dorsi-ventrally compressed, glabrous, truncate distally; ovary subglobose, 2.5–3.5 mm long, densely stellate-villose; style *c.* 0.3 mm long, glabrous; stigmatic limbs 3–3.5 mm long, glabrous; lobes ± spreading, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, 8–10 mm long, 7–10 mm across, stellate-tomentose, usually 3-seeded; calyx *c.* half the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, *c.* 6.5 mm long (including caruncle), 3.5 mm wide, and 2.8 mm deep; testa red-brown and blotched with dark brown; caruncle ± conical, *c.* 0.8 mm long, and 1 mm wide, ± wrinkled, yellowish-white.

***Additional specimens examined*: Western Australia.** Mt Heywood, Jan 1992, *Archer 101927* (MEL); Mt Heywood, 82 km NE of Esperance, Oct 1995, *Archer 210956* (MEL); Mt Beaumont, Aug 1983, *Burgman MAB1739* (PERTH); Mt Heywood, Sep 1983, *Burgman & McNee 2486* (PERTH); Mt Heywood, Aug 1980, *Clements 1827* (CANB); Gorge of Fitzgerald River, Sep 1948, *Gardner 9240* (PERTH); Fitzgerald River, May 1964, *Gardner 14767* (PERTH); N side of Mt Heyward [Heywood], Aug 1980, *George 15867* (PERTH); Tweetup [Twertup] Creek, Mar 1965, *Newbey 1754* (PERTH).

***Distribution and habitat*:** *Ricinocarpos trichophorus* is confined to the south coast of Western Australia where it is known from around Fitzgerald River and Twertup Creek, south west of Ravensthorpe, and Mt Heywood and Mt Beaumont NE of Esperance (**Map 22**). It is recorded as growing in shrubland communities on sandy soils on slopes amongst sandstone or granite boulders.

***Phenology*:** Flowers have been collected in January, March, May and from August to November, fruits in March, September and October.

***Affinities*:** *Ricinocarpos trichophorus* is similar to *R. velutinus* but differs from that species in having young shoots and inflorescence with a ferruginous indumentum, adaxial surface of leaf blades stellate-pubescent when young soon becoming glabrous and flowers with white petals.

22. Ricinocarpos trichophyllus Halford & R.J.F.Hend. **species nova** *R. marginatum* F.Muell. et *R. rosmarinifolio* Benth. maxime affinis. Ab illo foliorum lamina minore lineari usque ad angusto-oblonga non angusto-elliptica (22–45 mm longa × 1.4–3.5 (–6) mm lata non 45–90 mm longa × 8–20 mm lata) facile distincta. Ab hoc indumento in ramulis generatim plus grosso, foliorum lamina pagina adaxiali stellato-pubescenti non plus minusve glabra, floribus femineis calycis lobis lato-ovatis non angusto-triangularibus vel oblongis et ovario et fructu indumento densissimo pilis stellatis (pili minores quam 0.1 mm diam. non usque ad 0.3 mm diam.) differt. **Typus:** Northern Territory. Victoria River Region: Spirit Hills Conservation area, S of Nancy's Gorge, 20 August 1996, *I.Cowie 7144* (holo: BRI; iso: MEL [and according to label with holotype, DNA, CANB, AD, NSW, PERTH]).

Ricinocarpos sp. A., Wheeler (1992: 626).

Ricinocarpos sp. A. Kimberley Flora (A.S.George 14118), Paczkowska & Chapman (2000: 249).

Monoecious, open, slender **shrubs** 0.7–1.5 m high. Younger branchlets ± terete, with a moderately dense white indumentum; hairs stellate, ± sessile, multiangulate, 0.3–0.6 mm across. Older branchlets with surface becoming shallowly, longitudinally fissured, greyish-white. **Leaves** petiolate, spirally alternate; petioles 1.5–2 mm long, densely hairy with hairs as for branchlets; blades linear to narrow-oblong, 22–45 mm long, 1.4–3.5 (–6) mm wide, with a length/width ratio of 8–25:1; adaxial and abaxial surfaces moderately dense to densely pubescent with stipitate stellate hairs 0.2–0.4 mm across; base cuneate; margins recurved to revolute; apex obtuse to acute, occasionally ultimately apiculate with extension from midrib up to 0.1 mm long; midvein slightly impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or present on blade, up to 1 mm from base, 1 per side of midrib, sessile, smooth, 0.1–0.2 mm across. **Inflorescences** ± umbelliform usually of one female flower surrounded by 2 or 3 male flowers, initially terminal on branchlets but soon appears lateral as it is overtopped by growth of axillary buds; bracts and bracteoles linear, 1–1.5 mm long, stellate-pubescent, caducous. **Flowers** inconspicuous; pedicel white stellate-pubescent; calyx 5-lobed; petals 5, ± equalling or shorter than calyx; disc a glandular ring. **Male flowers:** pedicel slender, 2.5–10 mm long; calyx white stellate-pubescent abaxially, ± glabrous adaxially, lobes ovate to elliptic, 3–3.5 mm long, 2–2.5 mm wide, obtuse at the apex; petals broad-obovate, 1.9–3 mm long, 1.2–2.2 mm wide, of unknown colour when fresh, glabrous, with margins undulate, ± truncate at the apex; disc *c.* 0.2 mm long, dorsi-ventrally compressed, glabrous, lobed distally; lobes truncate to obtuse; central column *c.* 3.5 mm long, glabrous except for scattered stellate hairs proximally; stamens *c.* 25; free portion of filaments 2–2.5 mm long, ± erect at anthesis, glabrous; anthers 0.5–0.6 mm long. **Female flowers:** pedicel stout, 4–7 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes broad-ovate, 2.7–3 mm long, 2.2–2.6 mm wide, obtuse at the apex; petals spathulate, 2.3–2.5 mm long, 1–1.3 mm wide, of unknown colour when fresh, glabrous, with margins undulate, rounded at the apex, marcescent; disc as for male flowers; ovary subglobose, *c.* 2.5 mm long, densely stellate-pubescent; style 1.5–2 mm long, densely stellate-pubescent; stigmatic limbs of unknown colour when fresh, 1.3–1.5 mm long, glabrous adaxially, stellate-pubescent proximally abaxially; lobes strongly revolute, ± terete but grooved abaxially, ± verrucose adaxially, smooth abaxially. **Fruits** subglobose, trilobate, 6–8 mm long, 7.5–8 mm across, very densely stellate-pubescent with hairs up to 0.1 mm across, usually 3-seeded; calyx *c.* a third the length of mature fruit. **Seeds** ovoid, dorsi-ventrally compressed, *c.* 7 mm long (including caruncle), 4.5 mm wide and 3.5 mm deep; testa red-brown; caruncle ± reniform or pyramidal, *c.* 1 mm long and 2 mm wide, ± smooth, creamy-white or pale green. **Fig. 10.**

***Additional specimens examined*: Western Australia.** near Solea Fall, Drysdale River, Drysdale River N.P., Aug 1975, *George 13757* (CANB, PERTH); Planigale Creek, Drysdale River N.P., Aug 1975, *Kenneally 4460* (PERTH). **Northern Territory.** Moyle River, May 1994, *Dunlop 9831 & Latz* (BRI, MEL); Bradshaw Station, Feb 1999, *Michell & Yates 2130* (DNA); Spirit Hills, Nancy's Gorge, Aug 1996, *Michell 258* (DNA).

***Distribution and habitat*:** *Ricinocarpos trichophyllus* is confined to Drysdale River N.P., Kimberley, Western Australia and the Moyle and Victoria River areas of the Northern Territory (**Map 23**). It is recorded as growing in shrubland and eucalypt woodland communities on sandy soils associated with sandstone outcrops.

***Phenology*:** Flowers and fruits have been collected in February, May and August.

***Affinities*:** *Ricinocarpos trichophyllus* is similar to *R. marginatus* and *R. rosmarinifolius*. It is easily distinguished from *R. marginatus* by its smaller, linear to narrow-oblong rather than narrow-elliptic leaf blades (22–45 mm long × 1.4–3.5 (–6) mm wide compared with 45–90 mm long × 8–20 mm wide in *R. marginatus*).

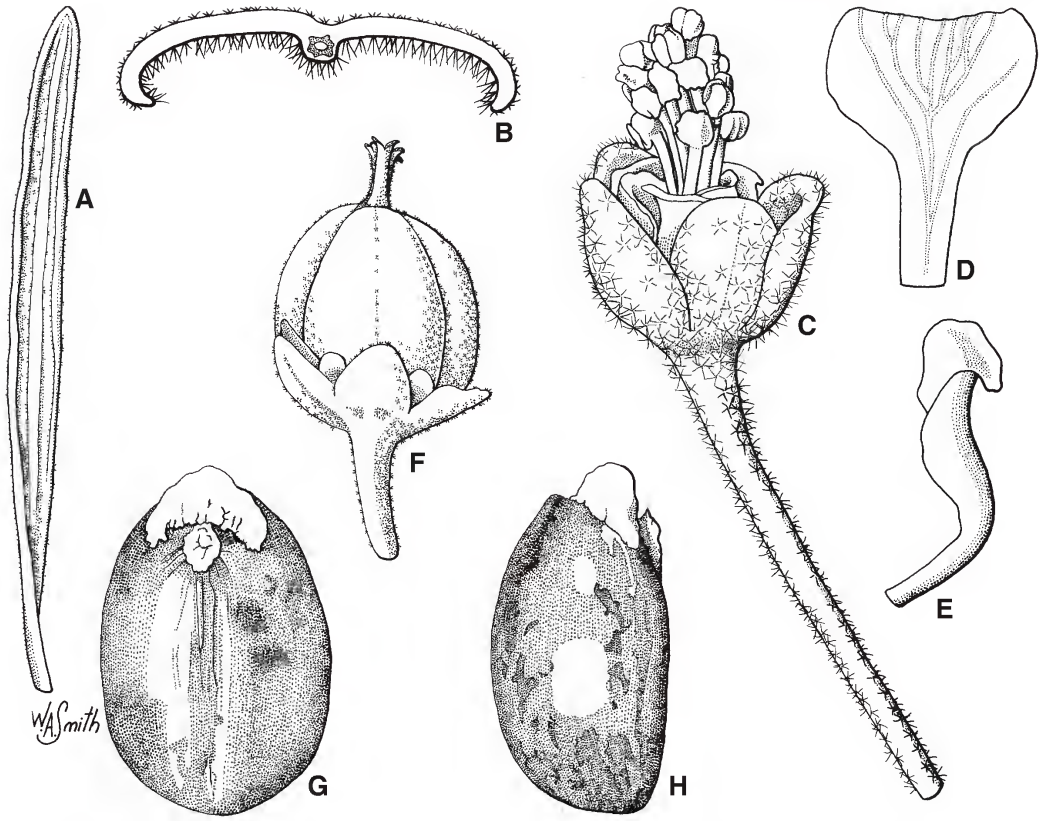


Fig. 10. ***Ricinocarpos trichophyllus.*** A. adaxial leaf surface × 4. B. transverse section of leaf × 16. C. side view of male flower × 8. D. adaxial view of petal from male flower × 16. E. side view of petal from male flower × 16. F. side view of fruit × 4. G. ventral view of seed × 6. H. side view of seed × 6. A–E from *Cowie 7144* (BRI); F from *Michell 258* (DNA); G, H from *Michell 2130 & Yates* (DNA). Del. W.Smith.

It differs from *R. rosmarinifolius* in its generally coarser indumentum on branchlets, its stellate-pubescent rather than ± glabrous adaxial surface of leaf blades, its broad-ovate rather than narrow-triangular or oblong calyx lobes in female flowers and the very dense indumentum of minute stellate hairs on its ovary and fruit (hairs less than 0.1 mm across compared with up to 0.3 mm across in *R. rosmarinifolius*).

***Etymology*:** The specific epithet is derived from Greek *tricho-* (hairy), and *-phyllus* (leaved), in reference to the persistent stellate indumentum on the upper surface of leaf blades in this species.

23. Ricinocarpos tuberculatus Müll.Arg., *Linnaea* 34: 60 (1865) (*'Ricinocarpus'*); *Roeperia tuberculata* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia] ad Swan River, *s.d.*, *J.Drummond ser. 4 n. 84* (holo: ?G-BOISS *n.v.*; iso: K).

***Illustration*:** Elliot & Jones (2002: 239).

Monoecious or dioecious, erect **shrubs or small trees** to 4 m high. Young branchlets subterete, glabrous, ±glaucous. Older branchlets with surface becoming shallowly longitudinally fissured and flaky, ± grey. **Leaves** petiolate, spirally alternate; petioles 1–3 mm long, glabrous; blades linear, 10–25 mm long, 0.8–1.3 mm wide, with a length/width ratio of 15–20:1; adaxial surface glabrous, ± smooth; abaxial surface puberulous with soft white crispate hairs up to 0.4 mm long; base cuneate; margins recurved to midrib so that only midrib of abaxial surface of leaf blade is visible; apex obtuse to acute, ultimately

mucronate with extension from midrib; mucro straight or slightly downwardly curved, up to 0.4 mm long; midvein obscure adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** ± umbelliform with either 2–7 male flowers or one central female flower surrounded by up to 5 male flowers, terminal on branchlets; bracts linear, 5–6 mm long, glabrous, caducous; bracteoles absent or when present, linear, 1–2 mm long, glabrous. **Flowers** conspicuous; pedicel glabrous; calyx 5-lobed; petals 5, *c.* four times as long as calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 12–22 mm long; calyx glabrous abaxially, moderately hairy with white crispate hairs adaxially, lobes triangular, 1.5–2.5 mm long, 1–1.5 mm wide, acute at the apex; petals narrow-obovate, 10–12 mm long, 2.5–4 mm wide, white, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins entire, obtuse at the apex; disc-glands 0.3–0.4 mm long, dorsi-ventrally compressed, glabrous, rounded distally; central column *c.* 4 mm long, pubescent; stamens *c.* 30; free portion of filaments 0.3–0.6 mm long, ± erect at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel usually stout, 5–10 mm long; calyx caducous, indumentum as for calyx of male flowers, lobes triangular, 1.2–2.2 mm long, 0.8–1 mm wide, acute at the apex; petals narrow-obovate, 10–12 mm long, 3–4 mm wide, white, glabrous except of tuft of appressed white simple hairs proximally on adaxial surface, with margins entire, rounded at the apex, caducous; disc-glands as for male flowers; ovary ovoid, *c.* 2 mm long, glabrous, verrucose; style ± obsolete; stigmatic limbs 2–2.5 mm long, glabrous; lobes spreading, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, 10–12 mm long, 7–8 mm across, glabrous, ± smooth, usually 3-seeded. **Seeds** ovoid, dorsi-ventrally compressed, 7–8 mm long (including caruncle), 3.5–3.7 mm wide, 2.5–2.7 mm deep; testa pale brown and blotched with dark brown; caruncle ± concial, *c.* 1.7 mm long and 2 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 15 examined)*: Western Australia.** between Bruce Rock and Narembeen, S of Merredin, Sep 1929, *Blackall s.n.* (PERTH); Kokerbin Hill, Oct 1983, *Cranfield 4854* (PERTH); Mt Caroline, S of Kellerberrin, Jan 1940, *Gardner s.n.* (PERTH); SE foothills of Mt Caroline, *c.* 19 km SSW of Kellerberrin, Sep 1988, *Henderson H3160* (BRI); Mt Caroline, SW of Kellerberrin, Oct 1963, *Jefferies 631001* (PERTH); Wildlife Reserve, 21 km SSE of Kellerberin, Apr 1986, *Neden 4* (CANB); Mt Stirling, Oct 1964, *Newbey 1572* (PERTH); Nangeen Hill, Bruce Rock Shire, Jul 1980, *Williams 10* (PERTH).

***Distribution and habitat*:** *Ricinocarpos tuberculatus* is confined to south-western Western Australia where it is restricted to the Kellerberrin–Bruce Rock area (**Map 24**). It is recorded as growing in shrubland communities on shallow sandy soils on hill slopes amongst granite rocks boulders.

***Phenology*:** Flowers have been collected in January, March, April, July and from September to November, fruits in January, July and from October to November.

***Affinities*:** *Ricinocarpos tuberculatus* is similar to *R. cyanescens* and *R. megalocarpus*. It differs from *R. cyanescens* in having generally longer leaves, 3-seeded fruits and a more or less smooth fruit surface. For features distinguishing *R. tuberculatus* from *R. megalocarpus*, refer to the 'Affinities' section under that species.

24. Ricinocarpos undulatus Lehm., *Pl. Preiss.* 2: 370 (1848) ('*Ricinocarpus*'); *Ricinocarpos glaucus* var. *undulatus* (Lehm.) Müll.Arg. in A.DC., *Prodr.* 15(2): 205 ('late Aug'1866) ('*Ricinocarpus*'). **Type:** [Western Australia] "In regionibus interioribus Australiae meridionali-occidentalis, m. Nov. 1810 Herb. Preiss. N. 2016 ex parte" (holo: ?, *n.v.*; iso: MEL 2065946 [ex herb. Sonder]; MEL 2062905 [ex herb. Sonder]; MEL 2066079; G-DC, *n.v.* [microfiche IDC 800-73. 2455: II. 3]).

Monoecious or apparently dioecious, erect spindly **shrubs** to 1.5 m high. Young branchlets subterete, moderately to densely hairy in two longitudinal bands; hairs simple, erect, up to 0.2 mm long. Older branchlets with surface becoming shallowly longitudinally fissured and flaky, greyish-white. **Leaves** petiolate, spirally alternate or occasionally subopposite; petioles 0.5–2 mm long, densely hairy adaxially with ± appressed simple hairs

up to 0.4 mm long, glabrous abaxially; blades linear, (5–) 13–35 mm long, (1–) 1.3–3 mm wide, with a length/width ratio of 7–20:1; adaxial surface glabrous, smooth; abaxial surface sericeous with loosely appressed soft straight hairs up to 2.3 mm long; base cuneate; margins recurved usually to midrib; apex obtuse to acute, ultimately mucronate with extension from midrib; mucro straight or slightly upwardly curved, up to 0.5 mm long; midvein slightly impressed adaxially, abaxially raised and glabrous on abaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single male or female flower, or ± umbelliform mostly with either 2–5 male flowers or one female flower surrounded by up to 3 male flowers, terminal on branchlets or sometimes appearing axillary due to reduction of lateral branchlet; bracts and bracteoles narrow-ovate, 2–4 mm long, stellate-pubescent on adaxial surface and on margins, glabrous abaxially, caducous. **Flowers** conspicuous, fragrant; pedicel glabrous; calyx 5-lobed; petals 5(rarely 6), *c.* five times as long as calyx; disc of 5(rarely 6) discrete glands. **Male flowers:** pedicel slender, 10–25 mm long; calyx glabrous abaxially, densely hairy with simple white hairs adaxially, lobes triangular or ovate, 2–3 mm long, 1.3–1.6 mm wide, acute or obtuse at the apex; petals narrow-obovate or oblong-obovate, 7–15 mm long, 2.2–4.5 mm wide, white adaxially, white with blushes of pink or maroon abaxially, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins entire, acute to obtuse at the apex; disc-glands *c.* 0.8 mm long, slightly dorsi-ventrally compressed, hairy adaxially with ± erect simple hairs *c.* 0.3 mm long, glabrous abaxially, rounded to truncate distally; central column 2–4 mm long, glabrous; stamens 15–25; free portion of filaments 0.6–1 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.5 mm long. **Female flowers:** pedicel slender, 5–25 mm long; calyx persistent, indumentum as for calyx of male flowers, lobes triangular or ovate, 2.3–3.2 mm long, 1.5–1.7 mm wide, acute at the apex; petals narrow-obovate, 8–12 mm long, 2.7–3.8 mm wide, white adaxially, white with shades of pink or maroon abaxially, glabrous except for tuft of white simple hairs proximally on adaxial surface, with margins entire, obtuse at the apex, caducous; disc-glands as for male flowers; ovary ovoid but trilobate, 2–2.7 mm long, glabrous, smooth; style *c.* 0.4 mm long, glabrous; stigmatic limbs 2–2.7 mm long, glabrous; lobes spreading to ascending, ± terete but grooved proximally abaxially, smooth on both surfaces. **Fruits** ellipsoidal, trilobate, 8–10 mm long, 6–7.5 mm across, glabrous, ± smooth, usually 3-seeded; calyx *c.* a fifth the length of mature fruit. **Seeds** ellipsoid, slightly dorsi-ventrally compressed, 5–6 mm long (including caruncle), 3.7–3.8 mm wide, 3–3.4 mm deep; testa pale brown and blotched with dark brown; caruncle ± hemispherical, 1.3–1.5 mm long, 1.8–1.9 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 57 examined)*: Western Australia.** Yerramullah track on the W edge of Badgingarra N.P., *c.* 4 km WSW of High Hill, Sep 1990, *Albrecht 4418 & Führer* (MEL); Wanneroo, Aug 1959, *Aplin s.n.* (PERTH); Badgingarra, Sep 1969, *Ashby 3042* (CANB, PERTH); N of Wubin, Sep 1970, *Ashby 3617* (PERTH); Lake Grace, Oct 1962, *Cough 40* (PERTH); Balga, Sep 1971, *Demarz D.3413* (PERTH); S side of Mullalloo Drive, 1 mile [*c.* 1.6 km] E of Marmion ave, Craigie, Oct 1975, *George 5* (PERTH); S of Jurien road, 3.5 km Wof Brand Highway, Oct 1979, *Griffin 2410* (PERTH); 20 km SSE of Lancelin on Wanneroo road, Aug 1979, *Haegi 1897* (PERTH); 11.7 km E of Green Head on road to Brand Highway, Sep 1979, *Haegi 1916* (PERTH); crest of ridge *c.* 1 km S of Ballidu, on road to Wongan Hills, Sep 1988, *Henderson H3156* (BRI); *c.* 5 km NE of Jurien, on road to Brand Highway, Sep 1988, *Henderson H3137* (BRI); *c.* 21 km SE of Lancelin, on road to Gingin, Sep 1988, *Henderson H3133* (BRI); 8 km E of Jurien Bay, Sep 1978, *Hnatiuk 780123* (PERTH); 11.5 km E of Jurien, Sep 1976, *Johnson 3246* (BRI); 5 miles [*c.* 8 km] N of Maya, Aug 1965, *Newbey 2082* (PERTH); 17 km W of York, Wambyn road at 850 m S of junction with Boyercutty road, Sep 1983, *Patrick 32* (PERTH); SW of Ballidu on catchment to town dam, Sep 1988, *Smith 1074* (BRI, MEL); New Geraldton road [Brand Highway], 2 miles [*c.* 3 km] N of the Watheroo–Jurien Bay crossroad, Sep 1966, *Smith 66/211* (PERTH, MEL); Lackman Dam, N of Korrelocking, Aug 1983, *Smith 256* (CANB, MEL).

***Distribution and habitat*:** *Ricinocarpos undulatus* is confined to south-western Western Australia where it occurs from near Green Head and Wubin southwards to Fremantle and east to Merredin and Lake Grace (**Map 25**). It has been recorded once in the Busselton region (*Stoward s.n.*, in 1916 (PERTH)). It is recorded as growing in heath, shrubland, mallee and open woodland

communities on a variety of sandy soils, either deep or shallow, over laterite or limestone.

***Phenology*:** Flowers have been collected from July to September, fruits from September to November.

***Affinities*:** *Ricinocarpos undulatus* is similar to *R. glaucus* and *R. pilifer*. It differs from *R. glaucus* in having a sericeous indumentum with loosely appressed soft straight hairs on the abaxial surface of leaf blades and flowers with petals that are white adaxially and shades of pink or maroon abaxially. For features distinguishing *R. undulatus* from *R. pilifer*, refer to the 'Affinities' section under the latter species.

***Notes*:** The combination *Ricinocarpos glaucus* var. *undulatus* was made independently by H. Baillon on or after 30 Aug 1866 (Henderson 1992). Thus, it is debatable who should be credited with first making it. We have assumed that it is more likely Müller's combination predates that of Baillon.

25. Ricinocarpos velutinus F.Muell., *Fragm.* 9: 2 (1875) ('*Ricinocarpus*'); *Roeperia velutina* (F.Muell.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia] Upper Irwin River, *s.d.*, *J.Forrest s.n.* (lecto [here chosen]: MEL 90951; isolecto: K, MEL 90950).

Plagianthus monoicus Ewart in Ewart & Tovey, *Proc. Roy. Soc. Victoria* 32: 203 (1920) ('*P. monoica*'). **Type:** Western Australia. near Lake Deborah, 25 November 1891, *R.Helms s.n.* (holo: MEL 90953; iso: MEL 90952, AD 96628004 and 97714338 *n.v.*).

***Illustration*:** Corrick & Führer (1996: 55).

Monoecious or rarely dioecious, dense erect **shrubs** to 2 m high. Young branchlets terete, with a dense white indumentum; hairs stellate, sessile or shortly stipitate, multiangulate, < 0.8 mm across, with stipes < 0.2 mm long. Older branchlets with surface becoming longitudinally ridged, reddish-brown. **Leaves** sessile or shortly petiolate, spirally alternate; petioles up to 1 mm long, densely hairy with hairs as for branchlets; blades linear or rarely narrow-oblong, (12–) 25–55 (–60) mm long, 1.5–4 (–7) mm wide, with a length/width ratio of 8–20:1; adaxial surface and abaxial surface tomentose with soft white stellate hairs up to 0.8 mm across; base cuneate to obtuse; margins recurved; apex acute or obtuse, sometimes with stipitate gland at tip; midvein impressed adaxially, abaxially raised and stellate-pubescent; secondary venation obscure on both surfaces; marginal glands absent or occasionally present on blade, up to 30 mm from base, 1 or 2 each side of midrib, stipitate, smooth, *c.* 0.3 mm across; stipes up to 0.1 mm long. **Inflorescences** racemose with all female or all male flowers or one or two female flowers basal on the axis with up to 13 male flowers distal to them, terminal on branchlets, frondobracteose; rachis 3–6 cm long; bracts linear, 3–10 mm long, densely stellate-pubescent adaxially and abaxially; bracteoles absent. **Flowers** conspicuous; pedicel densely hairy with white stellate hairs; calyx 5-lobed; petals 5, slightly longer than calyx; disc of 5 discrete glands. **Male flowers:** pedicel slender, 4–11 mm long; calyx densely tomentose with white stellate hairs abaxially and adaxially, lobes narrow-ovate to ovate, 4–7 mm long, 2–3 mm wide, acuminate at the apex; petals obovate, 6.5–8.5 mm long, 3–4 mm wide, yellow, glabrous except for tuft of woolly hairs proximally on adaxial surface, with margins entire, rounded at the apex; disc-glands 0.6–0.8 mm long, dorsi-ventrally compressed, sinuate, glabrous, irregularly lobed distally; central column *c.* 4 mm long, tomentose; stamens 40–70; free portion of filaments 1.8–3 mm long, erect to spreading at anthesis, glabrous; anthers *c.* 0.8 mm long. **Female flowers:** with pedicel stout, 5–15 mm long; calyx persistent, enlarging in fruit, indumentum as for calyx of male flowers, lobes ovate, 8–10 mm long in flower (9–20 mm long in fruit), 4–5 mm wide in flower (6–7 mm wide in fruit), acuminate at the apex; petals narrow-oblong, *c.* 7 mm long, and 2 mm wide, yellow, tomentose proximally on adaxial and abaxial surfaces, with margins entire, rounded or acute at the apex, marcescent; disc-glands *c.* 0.4 mm long, dorsi-ventrally compressed, glabrous or with scattered stellate hairs, truncate distally; ovary globose, *c.* 3 mm long, densely stellate-villose; style *c.* 0.4 mm long, stellate-pubescent; stigmatic limbs *c.* 6 mm long, glabrous adaxially, scattered stellate

hairs proximally abaxially; lobes spreading, ± dorsi-ventrally compressed or ± terete but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** ellipsoidal, 9–10 mm long, 9–12 mm across, stellate-villose, usually 3-seeded; calyx equal to or slightly longer than the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, 5.5–6 mm long (including caruncle), 3.2–3.7 mm wide, 2.6–3 mm deep; testa dark brown or greyish-white and blotched with dark reddish-brown; caruncle ± conical, *c.* 1 mm long, and 1.5 mm wide, ± smooth, yellowish-white.

***Additional selected specimens (from 74 examined)*: Western Australia.** 3 miles [*c.* 5 km] E of Dukin, Jun 1959, *Aplin 522* (CANB, PERTH); 25 miles [*c.* 40 km] S of Mullewa, Aug 1965, *Beard 4319* (CANB, PERTH); 43 miles [*c.* 69 km] SW of Yalgoo, Oct 1953, *Broadbent & Broadbent 1752* (CANB, PERTH); 82.5 miles [*c.* 133 km] E of Geraldton on Geraldton–Mullewa road, Mar 1968, *Carr 460* (MEL, PERTH); 0.5 km W of Pindar, *c.* 200 m N of Pindar–Geraldton Railway line, Sep 1985, *Conn 2039* (BRI, MEL); 34.5 km NE of Wubin on Payne's Find road, Aug 1976, *Coveny 7878 & Maslin* (PERTH); 3.6 km WSW of Calingiri road to intersection of Newdale road, Sep, 1983, *Cranfield 4282* (PERTH); Victoria location 8492, N of Perenjori, Apr 1979, *Cranfield 1257* (BRI, MEL, PERTH); Perenjori, Nov 1953, *Gardner 12156* (CANB, PERTH); *c.* 12 km SW of Mullewa, on road to Morawa, Sep 1988, *Henderson H3151* (BRI); *c.* 9 km NW of Three Springs, on The Midlands road to Mingenew, Sep 1988, *Henderson H3141* (BRI); *c.* 50 km direct NE of Perenjori, at 'Old Karara' station, Oct 1992, *Lyne 882 et al.* (BRI, MEL); 18 miles [*c.* 29 km] E of Pindar, on Geraldton–Mt Magnet road, Jul 1953, *Melville 4252 & Calaby* (MEL, PERTH); 'Tallering' Station, Nov 1981, *Mitchell 928* (PERTH); 17 miles [*c.* 27 km] S of Mullewa towards Morawa, Oct 1972, *Paust 1302* (CANB, PERTH); 50 km W of Mullewa along road to Geraldton, Oct 1986, *Roberts 739* (PERTH); 56.1 km from turn-off to Perenjori on Great Northern Highway between Paynes Find and Wubin, Sep 1982, *Ross 2753* (MEL, PERTH); beside Geraldton to Mt Magnet road, 14 miles [*c.* 23 km] E of Mullewa, Sep 1966, *Smith 66/410* (MEL, PERTH); *c.* 15 km S of Yuin Homestead toward Pindar, Oct 1975, *Weber 5092* (PERTH); 14 km S of Koorda, Mar 1961, *Wilson 6451* (PERTH).

***Distribution and habitat*:** *Ricinocarpos velutinus* is confined to south-western Western Australia where it occurs from the Mullewa area south-eastwards to Merredin and Coolgardie (**Map 26**). It is recorded as growing on a variety of sandy soils, sometimes gravelly, in shrubland or open woodland communities.

***Phenology*:** Flowers have been collected throughout the year particularly from August to October, fruits in January, May and from July to December.

***Affinities*:** *Ricinocarpos velutinus* is similar to *R. trichophorus* but differs from that in having young shoots and inflorescences with a greyish-white indumentum, adaxial surface of leaf blades with a moderately dense indumentum of persistent stellate hairs and flowers with yellow petals.

***Typification*:** In the protologue of *Ricinocarpos velutinus*, Mueller (1875) cited a single collection from the upper Irwin River [Western Australia] collected by J. Forrest. Three sheets (two at MEL [90951 and 90950] and one at K) with matching locality and collector data have been located amongst material on loan to BRI. The two sheets at MEL were annotated by Mueller with the name *R. velutinus*. All three sheets appear to be from a single collection. The sheet MEL90951 is selected here as lectotype of Mueller's name because the specimen is slightly more ample and better preserved than that on the other MEL sheet, whilst the specimen on the K sheet is a much smaller fragment than those on the MEL sheets.

Lander (1984) stated that the holotype of *Plagianthus monoica* had been destroyed in transit from Perth to Melbourne in the early 1980s but this, fortunately, is incorrect as the specimen is still extant and in MEL (90953).

Ricinocarpos sect. **Scissostylus** Grüning, in A. Engler, *Pflanzenr.* H.58: 48 (1913). **Type:** *Ricinocarpos stylosus* Diels.

Leaves with petiole appressed to branchlet. Inflorescences of a single flower or flowers umbelliform. Flowers with petals absent. Stigmatic limbs deeply 4- or 5-lobed.

26. Ricinocarpos stylosus Diels in L.Diels & E.Pritzel, *Bot. Jahrb. Syst.* 35: 335/336, fig. 40 (1904). **Type:** "Hab in distr. Coolagradie meridionali pr. Gilmores (a Lake Cowan occidentem versus) in fruticetis apertis arenoso-lutosis flor. et fruct, m. Nov. (D. 5272)" (holo: B †; lecto [here chosen]: Illustration in Diels & Pritzel, *Bot. Jahrb. Syst.* 35: 336, fig. 40 (1904)).

***Illustration*:** Grüning (1913: 49, fig. 9).

Monoecious or dioecious, spreading, rounded **shrubs** to 2 m high or rarely a small tree to 5 m high (*Spjut* 7277 *et al.* (PERTH)). Young branchlets terete, glabrous, resinous. Older branchlets with surface becoming shallowly longitudinally reticulately fissured, dark brown. **Leaves** petiolate, spirally alternate; petioles 1–2 mm long, glabrous; blades linear to narrow-oblong, 6–10 mm long, 1–1.5 mm wide, with a length/width ratio of 6–10:1; adaxial surface glabrous, ± smooth; abaxial surface puberulous with soft white stellate hairs < 0.1 mm across; base cuneate; margins recurved to midrib so that only midrib of abaxial surface of leaf blade is visible; apex acute to obtuse, ultimately mucronate with extension from midrib; midvein obscure adaxially, abaxially raised with flat glabrous adaxial face; secondary venation obscure on both surfaces; marginal glands absent. **Inflorescences** of a single female flower, or ± umbelliform with either 2–5 male flowers or one(rarely 2) female flowers surrounded by up to 4 male flowers, terminal on branchlets; bracts and bracteoles lanceolate, 3–5 mm long, glabrous. **Flowers** conspicuous; pedicel glabrous, usually resinous; calyx 4- or 5(rarely 6)-lobed; disc a glandular ring. **Male flowers:** pedicel slender, 3–5 mm long; calyx glabrous and usually resinous abaxially, glabrous or puberulous with minute white stellate hairs mostly near margins adaxially, lobes triangular, 2.7–3.7 mm long, 1.5–2.3 mm wide, acute or obtuse at the apex; disc 0.3–0.4 mm long, dorsi-ventrally compressed, irregularly lobed, glabrous except for scattered stellate hairs, truncate distally; central column *c.* 2 mm long, with scattered minute stellate hairs; stamens *c.* 35; free portion of filaments *c.* 0.5 mm long, erect to spreading at anthesis, glabrous; anthers 0.6–0.7 mm long. **Female flowers:** with pedicel usually stout, 3–6 mm long; calyx persistent, glabrous and usually resinous abaxially, glabrous or puberulous with minute white stellate hairs mostly near margins adaxially, lobes triangular, 3–4 mm long, 1.5–3 mm wide, acute to obtuse at the apex; disc as for male flowers; ovary ovoid but 3-sulcate, *c.* 1.5 mm long, glabrous or sparsely stellate-pubescent, verrucose; style ± obsolete; stigmatic limbs *c.* 2 mm long, glabrous; lobes spreading to ± upwardly curving, ± dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** subglobose, 7–8 mm long, 7–10 mm across, with scattered stellate hairs up to 0.1 mm across, rugose or verrucose, resinous, usually 3-seeded; calyx a quarter to half the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, 5–5.3 mm long (including caruncle), *c.* 3 mm wide, 1.7–1.8 mm deep; testa brown to dark brown; caruncle ± hemispherical, *c.* 0.7 mm long and 1.8 mm wide, ± smooth, yellowish-white.

***Additional selected specimens* (*from 40 examined*): Western Australia.** 5 km NE of Norseman PO (Post Office), *c.* 1 km N of Eyre Highway, Aug 1974, *Beauglehole ACB49391* (MEL, PERTH); 45 miles [*c.* 72 km] S of Norseman, Jan 1970, *Bennett 3085* (PERTH); 9.2 km SSW of Norseman, just S of Woolyeenyer Hill, Oct 1976, *Chinnock 3327* (PERTH); 30 km E of Norseman, Oct 1992, *Corrick 11020* (MEL); 46 km S of Norseman on the Esperance road, Oct 1981, *Craven 7207* (CANB, MEL); 4 miles [*c.* 6 km] E of Norseman, Oct 1973, *Demarz 4620* (PERTH); 5.6 km E of Norseman on Eyre Highway, Sep 1997, *Donaldson 1795 & Flowers* (CANB); *c.* 35 km N of Widgiemooltha, along Eyre Highway, Sep 1968, *Eichler 20043* (PERTH); 22 miles [*c.* 35 km] southward from Norseman, Nov 1953, *Gardner 11158* (PERTH); S of Coolgardie, Oct 1955, *Gauba WA248* (CANB); *c.* 41 km SE of Coolgardie, on road to Norseman, Sep 1988, *Henderson H3170* (BRI); north base of Jimberlana Hill, 7 km NE of Norseman, Oct 1979, *Newbey 6158* (PERTH); 28 km NW of Norseman, Nov 1979, *Newbey 6245* (PERTH); 93 miles [*c.* 149 km] N of Norseman, Nov 1962, *Phillips WA/62 3305* (CANB, PERTH); just S of Norseman, Oct 1981, *Spjut 7277 et al.* (PERTH); *c.* 95 km E of Norseman, Oct 1969, *Whibley 3015* (PERTH); 4 km S of Daniell, Sep 1964, *Wilson 3178* (PERTH).

***Distribution and habitat*:** *Ricinocarpos stylosus* occurs in south-western Western Australia where it is restricted to the Norseman district (**Map 27**). It is recorded as growing mostly on well-drained loam or clay soils in eucalypt woodland or open forest communities.

***Phenology*:** Flowers have been collected from August to January, fruits in April and from August to December.

***Affinities*:** *Ricinocarpos stylosus* is similar to *R. muricatus* Müll.Arg. and *R. verrucosus* Halford & R.J.F.Hend. in having apetalous flowers but differs from them in having

inflorescences of a single flower or umbelliform clusters of flowers and shorter leaves and petioles that are more or less appressed to the branchlet.

***Typification*:** We have been unable to locate the Diels collection (D. 5272) referred in the protologue of *R. stylosus*. The Diels herbarium was held at B and destroyed during the Second World War. Searches for duplicates in other herbaria where duplicates may exist according to Stafleu and Cowan (1976) (BM, MEL and CANB), have been unsuccessful. Diels' description and illustration are clearly diagnostic and leave no doubt as to the application of the name. The illustration in the protologue is here chosen as the lectotype of Diels' name *R. stylosus*.

Ricinocarpos sect. **Apetalidion** Müll. Arg., *Linnaea* 34: 59 (1865); *Ricinocarpos* sect. *Polystaphylos* Grüning, in A.Engler, *Pflanzenr.* H.58: 43 (1913) *nom. illeg.* **Type:** *Ricinocarpos muricatus* Müll.Arg.

Leaves with petiole spreading from branchlet. Inflorescences racemose, usually of one or two female flowers basal on the axis with many male flowers distal to them. Flowers with petals absent. Stigmatic limbs deeply 2–4-lobed.

27. Ricinocarpos muricatus Müll.Arg., *Linnaea* 34: 61 (1865); *Roeperia muricata* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 619 (1891). **Type:** [Western Australia] Swan River–Cape Riche, in 1848, [*J.*] *Drummond n. 85* (lecto [here chosen]: G-BOISS; isolecto: K [2 sheets]; G-DC *n.v.* [microfiche IDC 800-73. 2455: III. 2]).

***Illustration*:** Grüning (1913: 45, fig. 8 A-C).

Monecious, erect to spreading **shrubs** to 2.5 m high; thinly to thickly viscid on most parts. Young branchlets ± angular becoming terete with age, glabrous. Older branchlets with surface becoming longitudinally fissured, grey. **Leaves** sessile or shortly petiolate; petioles up to 1 mm long, glabrous; blades linear, (15–) 20–45 mm long, 1–2 mm wide, with a length/width ratio of (10–) 20–30:1; adaxial surface glabrous, with scattered tubercules; abaxial surface pubescent with soft stellate hairs up to 0.4 mm across; base cuneate; margins recurved to midrib; apex obtuse to rounded and ultimately terminated with ± sessile gland; midvein ± obscure adaxially, abaxially raised and angular, glabrous on abaxial face; secondary veins raised abaxially; marginal glands sometimes present at base of blade, 1 per side of midrib, sessile, smooth, 0.2–0.3 mm across. **Inflorescences** racemose usually of one or two female flowers basal on the axis with 8–12 male flowers distal to them; primary axis 15–30 mm long, glabrous, smooth; bracts lanceolate or narrow-oblong, 2.5–4 mm long, glabrous, caducous. **Flowers** conspicuous; pedicel glabrous, calyx 4- or 5-lobed. **Male flowers:** pedicel slender, 1–3 mm long; calyx glabrous except for white crispate hairs along the margins distally, lobes elliptic, 2.3–3 mm long, 1.4–2 mm wide, obtuse to rounded at the apex; disc of 5 discrete glands; glands dorsi-ventrally compressed, fleshy, glabrous; central column, 2–3 mm long, glabrous; stamens 20–30; filaments 0.2–0.5 mm long, spreading at anthesis, glabrous; anthers 0.7–0.8 mm long. **Female flowers:** pedicel ± slender, terete, 6–12 mm long; calyx persistent, glabrous, lobes narrow-ovate to broad-ovate, 2–4.4 mm long, 0.9–5 mm wide, acute to obtuse at the apex; disc a glandular ring, dorsi-ventrally compressed, fleshy, glabrous; ovary subglobose, 0.8–1.5 mm long, glabrous, tuberculate; style *c.* 0.3 mm long, glabrous; stigmatic limbs *c.* 3 mm long, deeply 2–4-lobed, glabrous; lobes spreading, dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** subglobose or ovoid, weakly to strongly trilobate, 5–7 mm long, 5–7 mm across, tuberculate to verrucose, glabrous, usually 3-seeded; calyx a third to half the length of mature fruit. **Seeds** obloid, *c.* 5 mm long (including caruncle), 3 mm wide and 2 mm deep; testa mottled greyish-white and lightly brown; caruncle ± broad-conical, *c.* 9 mm long and 1.2 mm wide, ± smooth, yellow-white.

***Selected specimens* (*from 42 examined*): Western Australia.** Mt Ridley, Oct 1970, *Aplin 4036* (PERTH); 420 mile peg, NW Coastal Highway, Aug 1967, *Ashby 2235* (PERTH); Noganyer Soak, Dundas Rocks, Sep 1977, *Barker 2578* (AD); 10 miles [*c.* 16 km] S of Norseman, Sep 1965, *Beauglehole ACB13215* (MEL, PERTH); Murchison Gorge, near Hawks Head, Jun 1968, *Blockley 639* (PERTH); 390.7 mile peg, Carnarvon

road [North West Coastal Highway], Sep 1974, *Demarz 5146* (PERTH); Mt Stirling, Jul 1941, *Gardner s.n.* (PERTH); Koolanooka Hills, Sep 1931, *Gardner 2673* (CANB, PERTH); near Z Bend, Kalbarri N.P., *c.* 30 km ENE of Kalbarri, Sep 1988, *Henderson H3145* (BRI); round picnic area in rocks at Dundas Rock, *c.* 23 km S of Norseman, Sep 1988, *Henderson H3173* (BRI); *c.* 37 km S of Dalwallinu, Jul 1980, *Hnatiuk 800038A* (PERTH); Wongan Hills, Aug 1980 *Kenneally 7462* (PERTH); *loc. cit.*, Jun 1983, *Kenneally 8791* (PERTH); Mt Caroline, 20 km SSW of Kellerberrin, Oct 1990, *Mollemans 3516* (BRI); 18 km E of Karroun Hill, Jul 1990, *Mollemans 2997* (CANB, BRI); Walyahmoning Rock, *c.* 60 km NW of Bullfinch, Sep 1982, *Newbey 9559* (CANB, PERTH); near Z Bend, Kalbarri N.P., Oct 1982, *Strid 20794* (PERTH); near Ross Graham Lookout, Kalbarri N.P., May 1968, *Wilson 6612* (PERTH); 8 km E of Ajana, May 1966, *Wilson 4128* (PERTH).

***Distribution and habitat*:** *Ricinocarpos muricatus* is confined to south-western Western Australia from near the Murchison River south-east to Mt Ridley near Esperance (**Map 28**). It is recorded as growing in sandy to sandy loam soils, mostly associated with granite substrates, sometimes with lateritic substrates, rarely on sand dunes and sandstone substrates, in mixed shrubland, heathland and mallee communities.

***Phenology*:** Flowers have been collected from April to November, fruits from July to October.

***Affinities*:** *Ricinocarpos muricatus* is similar to *R. verrucosus*. For features distinguishing these two species, refer to the 'Affinities' section under *R. verrucosus*. *Ricinocarpos muricatus* is similar to *R. stylosus* in having apetalous flowers but differs from that in having racemose inflorescences and longer leaves with spreading petioles.

***Typification*:** Müller (1865) cited two collections in the protologue of *R. muricatus*, namely "Ad Swan River (Drummond ser. 4 n. 85! et n. 218! in hb. Boiss." Both sheets are now located at G. Both sheets agree with the description in the protologue of *R. muricatus*. The better of these two collections (*Drummond n 85*) has flowers and fruit and is selected here as lectotype of Müller's name.

***Notes*:** Collections (e.g. *Blockley 639* (PERTH), *Ashby 2235* (PERTH), *Wilson 4128* (PERTH), *Henderson H3145* (BRI)) from the north-eastern end of the species range have broad-ovate female calyx lobes and a more deeply verrucose surface on the fruit. This variation is worthy of further investigation.

28. Ricinocarpos verrucosus Halford & R.J.F.Hend. **species nova** *R. muricato* Müll. Arg. maxime affinis sed foliorum lamina majore angusto-elliptica vel angusto-lanceolata non lineari in ambitu (45–100 mm longa × 2–4 mm lata non 15–45 mm longa × 1–2 mm lata), calycis lobis dense pubescentibus non glabris in pagina abaxiali et fructibus sparse pubescentibus non glabris differt. *R. verrucosus* floribus apetalis *R. styloso* Diels similis sed inflorescentiis racemosis non floris singularis vel umbellatis et foliorum lamina longiore (45–100 mm longa non 6–10 mm longa) et petiolo patenti non plus minusve ramulo appresso differt. **Typus:** Queensland. Cook District: Mt Alto, *c.* 4 km SSW of Mt Carbine, 21 April 1989, *R.J.F.Henderson H3228 & J.R.Clarkson* (holo: BRI; iso: DNA, CANB, MEL, NSW, K, distribuendi).

Ricinocarpos sp. (Mt Alto C.T.White 10633), Forster & Halford (2002: 73; 2007: 72).

Monoecious, multi-stemmed **shrubs** to 4 m high; thinly viscid on most parts. Young branchlets ± terete, glabrous. Older branchlets with surface becoming shallowly longitudinally fissured, ± black. **Leaves** shortly petiolate; petiole 1.4–2 mm long, glabrous; blade very narrow-elliptic or narrow-lanceolate, 45–100 mm long, 2–4 mm wide, with a length/width ratio of 11–30:1; adaxial surface glabrous and smooth; abaxial surface pubescent with soft stellate hairs up to 0.1 mm across; base attenuate; margins recurved; apex acute and ultimately terminated with sessile gland; midvein impressed adaxially, abaxially raised and rounded, glabrous on abaxial face; secondary veins raised abaxially; marginal glands sometimes present at base of blade, 1 per side of midrib, sessile, smooth, *c.* 0.1 mm across. **Inflorescences** racemose usually of one or two female flowers basal on the axis with 8–20 male flowers distal to them; primary axis 20–50 mm long, glabrous, smooth; bracts narrow-oblong, 2.6–3 mm long, glabrous, caducous. **Flowers** with pedicel glabrous; calyx 4- or 5-lobed; disc ± a glandular ring, dorsi-ventrally compressed, fleshy, lobed distally. **Male flowers:** pedicel slender, 2–3 mm long; calyx glabrous except

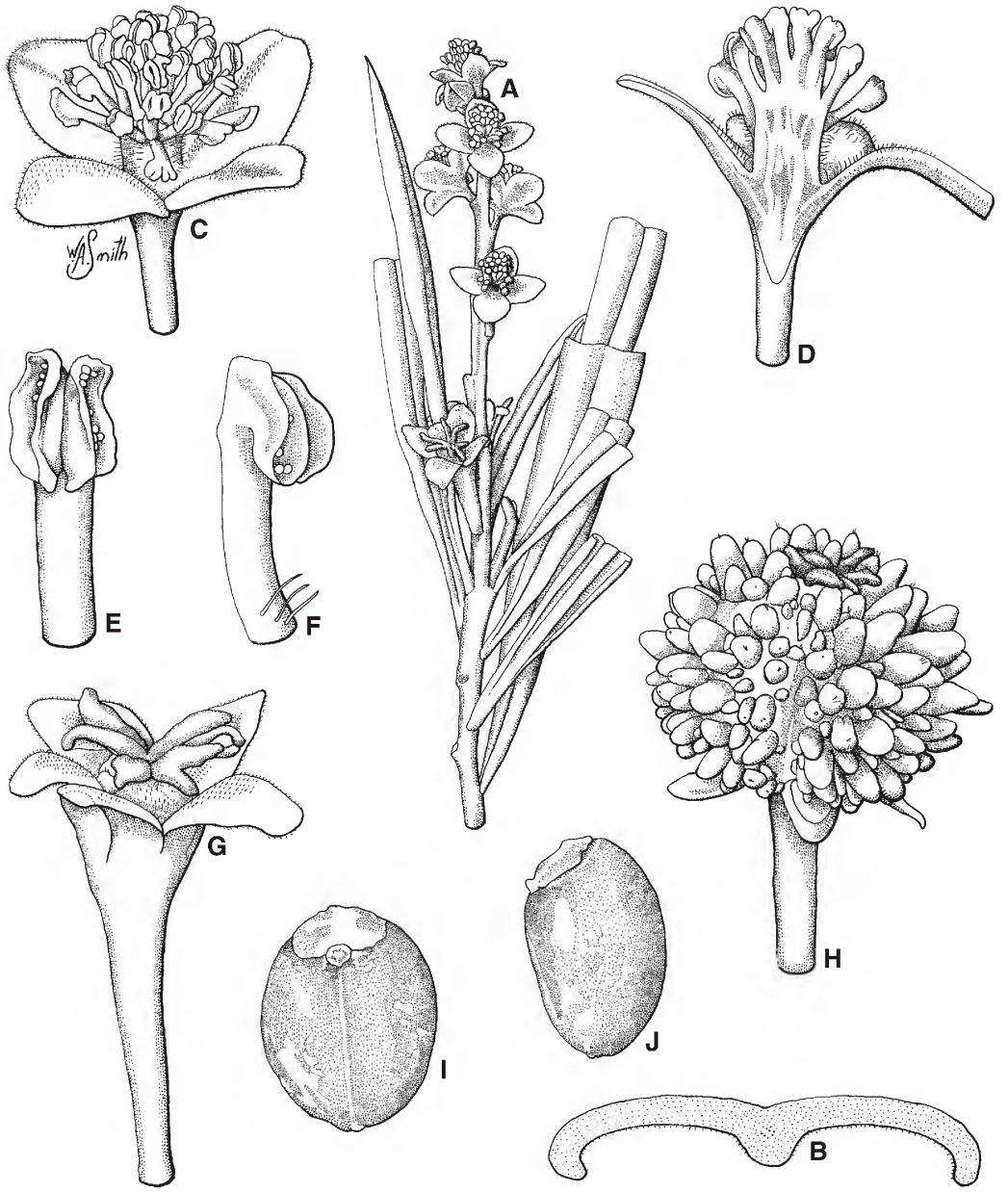


Fig. 11. ***Ricinocarpos verrucosus.*** A. flowering branchlet × 2. B. transverse section of leaf × 12. C. side view of male flower × 8. D. longitudinal section of male flower × 8. E face view of stamen × 30. F. side view of stamen × 30. G. side view of female flower × 6. H. side view of fruit × 4. I. ventral view of seed × 6. J. side view of seed × 6. A–G from *Clarkson 8215* (BRI); H from *Henderson H3228 & Clarkson* (BRI); I, J from *Gray 6628* (BRI). Del. W.Smith.

for dense minute hairs distally abaxially, densely pubescent adaxially, lobes ovate to elliptic, 2.5–3.3 mm long, 2.2–2.7 mm wide, obtuse to acute at the apex; disc hairy; central column 2–3.3 mm long, tomentose; stamens *c.* 40; free portion of filaments *c.* 1.3 mm long, erect to spreading at anthesis, glabrous or sparsely hairy; anthers 0.6–0.8 mm long. **Female flowers:** pedicel stout, 5–10 mm long, glabrous; calyx persistent, indumentum as for calyx of male flowers, lobes narrow-ovate to ovate, 3.4–4.2 mm long, 1.5–2.9 mm

wide, acute at the apex; disc glabrous; ovary subglobose, *c.* 2 mm long, stellate-pubescent, verrucose; style ± obsolete; stigmatic limbs spreading, 2–2.5 mm long, deeply 2- or 3-lobed, glabrous adaxially, stellate-pubescent proximally abaxially; lobes spreading, dorsi-ventrally compressed but grooved abaxially, verrucose adaxially, smooth abaxially. **Fruits** subglobose, 6–8 mm long, 9–10 mm across, verrucose, sparsely hairy with stellate hairs, usually 3-seeded; calyx < a third the length of mature fruit. **Seeds** ellipsoid, dorsi-ventrally compressed, *c.* 5 mm long (including caruncle), 3.5 mm wide and 3 mm deep; testa dark red-brown; caruncle ± hemispherical, *c.* 4 mm long and 2 mm wide, ± smooth, yellow-white. **Fig. 11.**

***Additional selected specimens*: Queensland.** Cook District: Right-hand Falls, Mt Carbine, Nov 1967, *Cassels CAIRNS14893* (BRI); Mt Alto, *c.* 4 km SSW of Mt Carbine, Feb 1990, *Clarkson 8215* (BRI); *loc. cit.*, Feb 1990, *Clarkson 8214* (BRI); McLeod River, between falls and Mount Spurgeon road crossing, Dec 1988, *Fell DF1542* (BRI); 1.6 km E of Flat Hill, Cape Melville N.P., May 1993, *Fell DGF3221 & Stanton* (BRI); *loc. cit.*, May 1994, *Fell DGF4355* (BRI); Bakers Blue Mountain, Font Hills, Feb 1996, *Gray 6628* (BRI); Mt Alto, near Mt Carbine, Sep 1936, *White 10633* (BRI).

***Distribution and habitat*:** *Ricinocarpos verrucosus* is confined to north-eastern Queensland in Cape Melville National Park, and the Mount Carbine district north of Mareeba (**Map 29**). It is recorded as growing mostly amongst granite boulders on rocky hillsides, cliff-lines or on rocky stream banks, often in open woodland communities fringing vine thickets. It is also recorded on dissected ferruginous sandstone.

***Phenology*:** Flowers have been collected from February, May, September to November, fruits from February.

***Affinities*:** *Ricinocarpos verrucosus* is similar to *R. muricatus* but can be distinguished from that species by its larger leaf blades which are narrow-elliptic or narrow-lanceolate rather than linear in outline (45–100 mm long × 2–4 mm wide compared with 15–45 mm long × 1–2 mm wide), its calyx lobes densely hairy (versus glabrous) on the abaxial surface, and its sparsely hairy (not glabrous) fruit. *Ricinocarpos verrucosus* is similar to *R. stylosus* in having apetalous flowers but differs from that species in having racemose inflorescences, not of a single flower or umbellate, and leaves with a longer blade (45–100 mm long not 6–10 mm long) and a spreading petiole, not more or less appressed to the branchlet.

***Etymology*:** The specific epithet is from Latin, *verrucosus* (warty), and refers to the warty texture of the surface of the fruit of this species.

Excluded names

Ricinocarpos major Müll.Arg., *Linnaea* 34: 59 (1865) ('*Ricinocarpus*'); *Roeperia major* (Müll.Arg.) Kuntze, *Revis. Gen. Pl.* 2: 618 (1891). **Type:** in Tasmania, *Verreaux 112* (holo: G-DC [microfiche IDC 800-73. 2455: I. 3]).

A specimen at MEL [2066058] may be a fragment (leaves only) of the *Verreaux* collection at G-DC. A floral diagram of a female flower in pencil is attached to the sheet with a note "Copied von der Etiguette in hb DC, Ricinocarpus major" (copied from the label in herb. de Candolle). However, there is no such diagram with the specimen illustrated on the microfiche. Examination of the microfiche and the fragment on the MEL sheet suggest that the taxon it represents does not belong to Euphorbiaceae.

Ricinocarpos mitchellii Sonder, *Linnaea* 28: 563 (1857) ('*Ricinocarpus Mitchelli*'); *Bertya mitchellii* (Sond.) Müll.Arg., *Linnaea* 34: 63 (1865); *Bertya mitchellii* (Sond.) Müll. Arg. var. *mitchellii*, Grüning in A.Engler, *Pflanzenr.* H.58: 61 (1913) = ***Bertya oleifolia*** Planch., *fide* Halford & Henderson (2002).

Ricinocarpos neocaledonicus S.Moore, *J. Linn. Soc., Bot.* 45: 394 (1921) = ***Baloghia neocaledonica*** (S.Moore) McPherson, *fide* McPherson & Tirel (1987).

Ricinocarpos tasmanicus Sonder & F.Muell., *Linnaea* 28: 562 (1857) = ***Bertya tasmanica*** (Sonder & F.Muell.) Müll.Arg., *fide* Halford & Henderson (2002).

Ricinocarpos sect. *Amonodiscus* Müll.Arg., *Linnaea* 34: 59 (1865). **Type:** *Ricinocarpos major* Müll.Arg.

See under *Ricinocarpos major* above.

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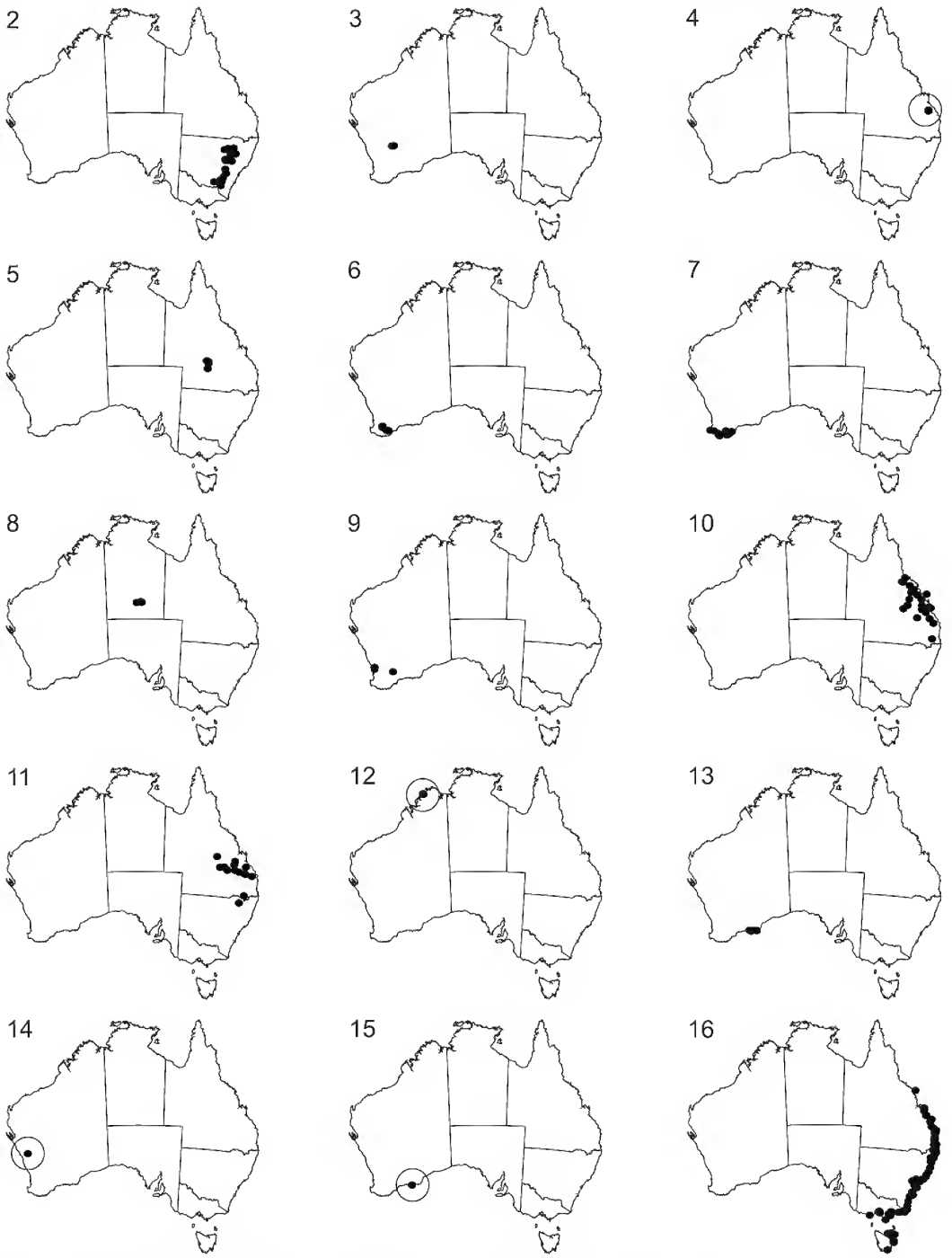

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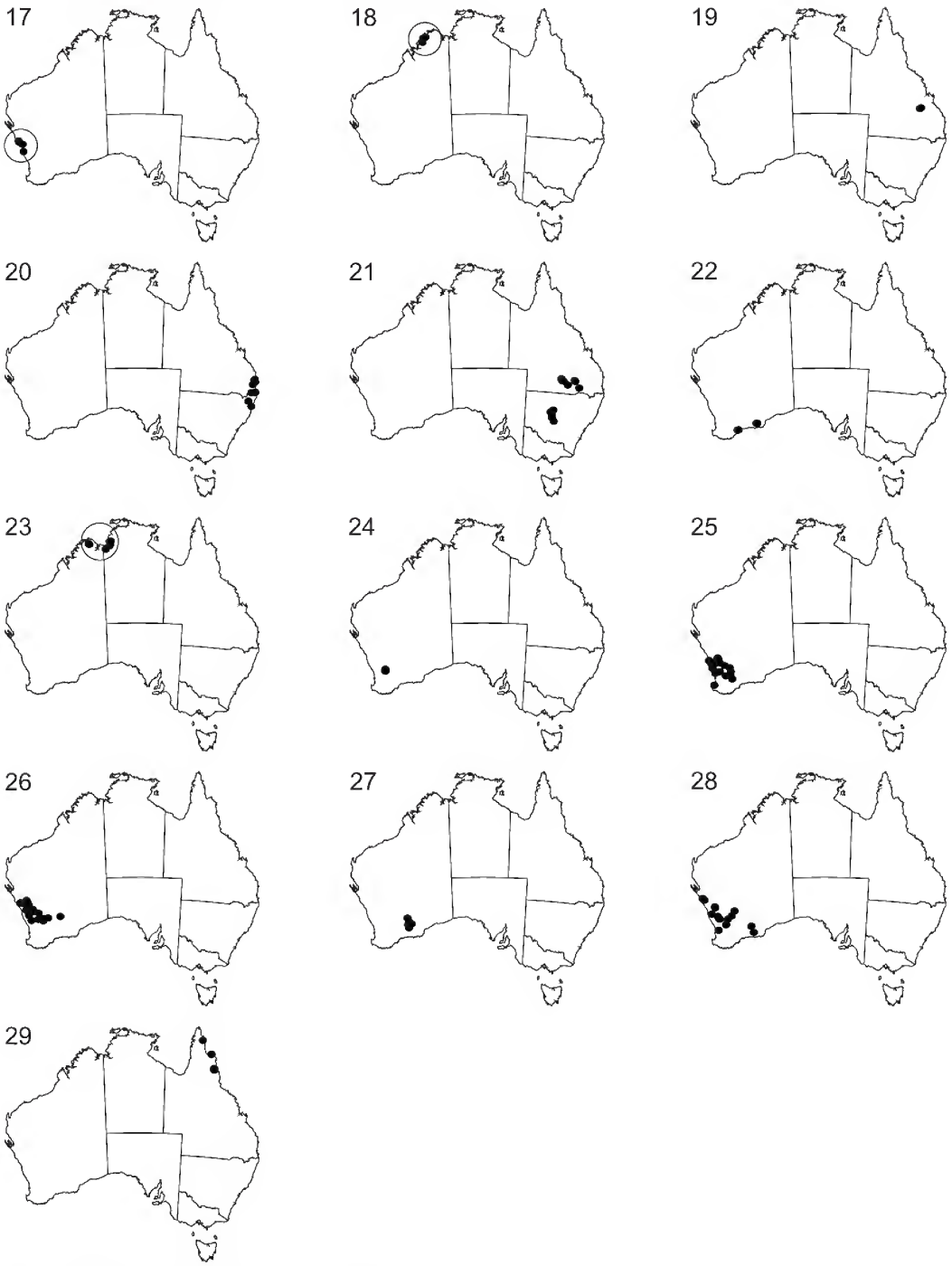

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A taxonomic revision of *Claoxylon* A.Juss. (Euphorbiaceae) in Australia

Paul I. Forster

Summary

Forster, P.I. (2007). A taxonomic revision of *Claoxylon* A.Juss. (Euphorbiaceae) in Australia. *Austrobaileya* 7(3): 451–472. The genus *Claoxylon* A.Juss. comprises four species in Australia, exclusive of Christmas Island, namely: *C. angustifolium* Müll.Arg., *C. australe* Baill., *C. hillii* Benth. and *C. tenerifolium* (F.Muell. ex. Baill.) F.Muell. *Claoxylon hillii* is reinstated from the synonymy of *C. tenerifolium*. *Claoxylon tenerifolium* comprises two subspecies with subsp. *boreale* P.I.Forst. newly described from the 'Wet Tropics' of north-eastern Queensland. All taxa are described and illustrated, together with notes on typification, variation, distribution, habitat, conservation status and etymology. A lectotype is designated for *Mercurialis tenerifolia* F.Muell. ex Baill. (= *Claoxylon tenerifolium* (F.Muell. ex Baill.) F.Muell.).

Key Words: Euphorbiaceae, *Claoxylon*, *Claoxylon hillii*, *Claoxylon tenerifolium* subsp. *boreale*, Australia, Australian flora, taxonomy, nomenclature, typification, identification key

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Introduction

The genus *Claoxylon* was described by Jussieu (1824) based on the single species *C. parviflorum* A.Juss. from the Mascarenes (Reunion and Rodrigues). Approximately 113 species are currently recognised (Govaerts *et al.* 2000), and are distributed in the Old World tropics in Madagascar, the Mascarenes, Asia, Malesia, Australia and the western Pacific as far east as Hawai'i. *Claoxylon* was included by Webster (1994) in Euphorbiaceae subfamily *Acalyphoideae* Asch., tribe *Acalypheae* Dumort, subtribe *Claoxylinae* Hurus. together with *Amyrea* Baill., *Claoxylopsis* Leandri, *Discoclaoxylon* (Muell.Arg.) Pax & K.Hoffm., *Erythrococca* Benth., *Mareya* Baill. and *Micrococca* Benth. Radcliffe-Smith (2001) had a similar arrangement but excluded *Amyrea* and *Mareya* from this subtribe. Recent molecular based phylogenies have placed *Claoxylon* in a clade with *Discoclaoxylon*, *Erythrococca*, *Lobanilia* Radcl.-Sm. and *Micrococca* (Wurdack *et al.* 2005). Taxa included in this genus have a unique character of the dry leaf surface being 'rough' due to slightly protruding styloid crystals (Kabouw *et al.* 2007). Whilst there have been a number of regional accounts of *Claoxylon* (e.g. India: Rani & Balakrishnan 1995; New Guinea: Airy Shaw 1980a; Thailand: van Welzen 2005), the last overall revision was by Pax (1914).

A specimen of *Claoxylon* was first collected from Australia by Joseph Banks and Daniel Solander when they were marooned at the Endeavour River between 17 June and 3 August 1770 following the collision of Captain Cook's ship the H.M.B. Endeavour on the Great Barrier Reef. This material (*Claoxylon hillii* Benth.) was illustrated by Sydney Parkinson (available online at www.jbanks.com) and specimens are present in a number of herbaria (e.g. BM, NSW). The first species of *Claoxylon* formally recognised for Australia was *C. australe* Baill. based on a collection by the explorer Ludwig Leichhardt in 1845 (Baillon 1858). This was quickly followed by the descriptions of *C. angustifolium* Müll.Arg. (Müller 1865) and *Mercurialis tenerifolia* F.Muell. ex Baill. (Baillon 1866), the latter subsequently recombined as *C. tenerifolium* (F.Muell. ex Baill.) F.Muell. (Mueller 1868). Bentham (1873) added *C. hillii* Benth. and the varieties *C. australe* var. *latifolia* Benth., *C. australe* var. *laxiflora* Benth. and *C.australe* var. *dentata* Benth. These concepts were repeated by Bailey (1901) and it was not until Airy Shaw (1976, 1980a,b, 1981) revised the Australian Euphorbiaceae in part, that any change to the *status quo* was

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attempted. Airy Shaw placed *Claoxylon hillii* in synonymy with *C. tenerifolium*, and also reduced Bentham's varieties of *C. australe* to synonymy with *C. australe* and *C. tenerifolium* respectively. The concept of three Australian species of *Claoxylon* was maintained until recently (e.g. Forster & Henderson 1997; Govaerts *et al.* 2000; Forster & Halford 2002), with the name *C. tenerifolium* being widely used for a 'species' that occurred from southern Queensland, north to tropical parts of Queensland, Western Australia and the Northern Territory (Wheeler 1992; Dunlop *et al.* 1995) and southern New Guinea (Airy Shaw 1980a).

The current revision is limited to mainland Australia and immediate offshore continental islands and coral cays. The Australian territory of Christmas Island has populations of *C. indicum* (Reinw. ex Blume) Hassk. (otherwise widespread in Malesia, Indochina and mainland Asia), and an account of this species is given by Du Puy & Telford (1993) together with illustrations in Claussen (2005). A much greater number of collections from mainland Australia are now available than were available to Airy Shaw (1980b, 1981). It is now evident that his reduction of *Claoxylon hillii* to synonymy with *C. tenerifolium* was in error as there are a number of easily discernible diagnostic characters that enable separation of the two as species. In addition, description of one new subspecies of *Claoxylon tenerifolium* is now possible following collection of adequate flowering material in 2001.

General Ecology & Reproductive Biology

The ecology of *Claoxylon* species has been barely studied and most information is merely anecdotal with respect to their reproduction, pollination, dispersal and recruitment as in the case of *Actephila* (Forster 2005). Unlike *Actephila*, the Australian species of *Claoxylon* can be interpreted as pioneers within the rainforest habitat due to their occurrence predominantly on the margins, in areas of disturbance or of high incident radiation (e.g. fragmented vinethicket canopies). While plants of *Claoxylon* are able to persist in shaded situations, they may exhibit increased numbers following gap formation or removal of competing plants (e.g. *Lantana camara*; Macleay 2004) and are generally considered to be light demanding (Green *et al.* 2004), although some non-Australian species appear well suited to life in the understorey in terms of their being able to reach maturity and reproduce (Pearcy 1983; Pearcy & Calkin 1983).

The four Australian species of *Claoxylon* appear dioecious as a population consists of plants that have either staminate or pistillate of flowers. Occasionally 'male' plants will have a few pistillate flowers in the inflorescences indicating that they may be actually monoecious. Species of *Claoxylon* are stated to be 'usually dioecious' (Floyd 1989; Wheeler 1992; James & Harden 2000; Adam & Williams 2001) or 'dioecious or rarely monoecious' (Bentham 1873; Bailey 1901; Stanley 1983; Florence 1997; Radcliffe-Smith 2001), although elsewhere they are listed as 'dioecious' (Smith 1981), 'monoecious' (Sakai *et al.* 1995) or 'monoecious or dioecious' (Wagner *et al.* 1989). Whether the apparent dioecy of the Australian taxa is fixed or subject to gender diphasy (the plants 'change sex') or is merely a case of androdioecy (male only and hermaphroditic individuals) is not known and requires long term observation of individual plants. In the Australian species the staminate flowers are usually larger in size than the pistillate ones (though not in *C. angustifolium*), a trait repeated outside of the region (Humeau *et al.* 2003). Additionally, staminate inflorescences and the overall number of staminate flowers greatly out numbers pistillate ones within any given population (pers. obs.).

The pollination dynamics of *Claoxylon* are unknown. Wind pollination is listed by Sakai *et al.* (1995); however, this is unlikely for a number of reasons. In many cases the plants are within the understorey of the rainforest, where windspeeds are much reduced (Turner 2001). The flowers are small and insignificant but generally conform to the shallow, bowl-like pattern that is considered suited to generalist insect pollinators (Endress 1994). Their general form is not dissimilar to those of either *Actephila* Blume or *Croton* L., both thought to be insect pollinated (Forster

2003, 2005). The pollen of *Claoxylon* (based mainly on taxa outside of Australia) is of a generalised type and has tecta that are punctate-microspinulose (Nowicke *et al.* 2002). This tends to support the suggestion that wind pollination is unlikely if the hypothesis of Williams & Adam (1999) that rainforest taxa with smooth pollen are more likely to be wind pollinated is eventually proven valid. Abe (2006) listed bee, fly and wind pollination systems for *C. centenarium* Koidz. from the Ogasawara Islands, but did not provide any experimental details of their individual effectiveness.

Fruiting is usually a mass event for a 'female' *Claoxylon*. The seeds (with covering arils) are not shed from the capsules following dehiscence, but remain attached to the central columella often with complete shedding of the fruit endocarp. The individual fleshy arils (usually orange to orange-red) are visually striking to the human eye and are attractive to birds (**Table 1**) that disperse the seeds (zoochory) (Innis 1989; Kitamura *et al.* 2002). The presence of some widespread species on isolated islands (e.g. *C. indicum* on Christmas Island) has been attributed to long range dispersal by arboreal avifauna (Whittaker *et al.* 1997). Ornithologist S. Legge (http://www.birdhealth.com.au/bird/eclectus/research.html) has noted that Eclectus Parrots eat only the aril of *Claoxylon hillii* but not the seeds and further research is required to see if this parrot also disperses the seeds. In some species the endocarp also colours yellow (e.g. *Claoxylon fallax* Müll.Arg. from Tonga; Meehan *et al.* 2002) or pale orange (*C. tenerifolium*) when the fruits are ripe, further supporting the hypothesis of zoochorous dispersal. Saulei & Swaine (1988) found with *C. ledermanii* Airy Shaw from New Guinea that the appearance of the species in rainforest successional stages was due to seed rain (presumably from avian dispersal) rather than any stored seed bank.

Table 1. Records of birds feeding on fruit of Australian *Claoxylon* species

Claoxylon species	Birds feeding on fruit	Reference
C. australe	Brown Cuckoo Dove; King Parrots	Floyd 1989; Innis 1989
C. hillii	Eclectus Parrot	Cooper & Cooper 2004
C. tenerifolium	Brown Cuckoo Dove	Cooper & Cooper 2004

Materials and methods

This revision is based on herbarium holdings at AD, BRI, CANB (including CBG), DNA, MEL, NSW, PERTH and QRS, selected type material at K and G, and field collections and observations by the author of all species. Venation data in the species descriptions follow the terminology of Hickey (1973) and Ash *et al.* (1999). In their scheme the different components of venation are described using a numerical system with the recognition of a midrib (1° vein order), lateral veins (2° vein order) and intercostal veins (3° and onwards vein orders) within any leaf lamina. When an intercostal vein comprises a continuous raised line of cells it is termed 'distinct'; if it is discontinuous or fades away into the body of the lamina, it is termed 'indistinct'. Indumentum cover is described using the terminology of Hewson (1988), except that 'scattered' is used instead of 'isolated'. The shapes of leaves, sepals and petals are described using the terminology of Hickey & King (2000).

Species are defined as groups of populations (1-many) with discontinuities in two or more independent character states of morphology. If a single character state difference is present, or there is repeatable variation in minor characters such as indumentum cover, and where the discontinuity is geographically based, then the rank of subspecies is used. These are species and subspecies definitions that are widely used and understood (Stebbins

1950; van Steenis 1957; Cronquist 1988; Stace 1989; Stuessy 1990; Levin 1979, 2000), the former equating to the 'diagnostic species' concept of Judd *et al.* (2002). This concept as used herein is tied to habitat preference and geographic distribution, based on extensive fieldwork in New South Wales, the Northern Territory and Queensland over the last 20 years.

Common abbreviations: N.P. = National Park; S.F.R. or S.F. = State Forest Reserve; L.A. = Logging Area. Rainforest structural terminology follows Webb (1978). The 'Wet Tropics' is defined as that area of north-eastern Queensland which encompasses the 'hot, humid vine forests' from near Cooktown in the north to Paluma in the south (Webb & Tracey 1981), and is equivalent to the bioregion of the same name (Goosem *et al.* 1999). 'Cape York Peninsula' is that part of Queensland north of the 'Wet Tropics'.

Taxa are arranged alphabetically. *Claoxylon indicum* is included in the key to species but is not treated in the main text. An account of that species can be found in Du Puy & Telford (1993).

Taxonomy

Claoxylon A.Juss., *Euphorb. Gen.* 43, t. 14, f. 43 (1824). **Type:** *C. parviflorum* A.Juss.

***Etymology*:** from the Greek *klao* (I break) and *xylon* (wood); alluding to the brittle wood.

Shrubs or small trees, evergreen or deciduous, perennial, monoecious or dioecious; stems and foliage without latex. Indumentum of simple, multicellular trichomes, glandular trichomes absent, stinging trichomes absent. Stipules entire, inconspicuous, deciduous. Leaves alternate, petiolate, elobate, penninerved, crenate or serrate, usually purple when young, drying dull-green, purple-black or blue-black and with a 'rough' surface due to slightly protruding styloid crystals, glands absent or foliar only. Inflorescences axillary or lateral, racemose, solitary, fasciculate or racemulose with flowers in bracteate glomerules, bisexual. Staminate flowers pedicellate; calyx lobes 2–4, valvate, free and ± equal; petals absent; disk of numerous interstaminal glands; stamens 10–200, filaments free and attached to a slightly convex receptacle; anthers basifixed, bilobate, thecae globose to oblong and longitudinally dehiscent; pistillodes absent. Pistillate flowers pedicellate; calyx lobes 3, valvate, shortly connate; petals absent; disk hypogynous, annular; ovary 2–4-locular, ovules uniloculate; styles shortly connate at base, simple and spreading. Fruits capsular, trilobate, surface smooth, dehiscing septicidally into 3 bivalved cocci. Seeds globose, ecarunculate, arillate; testa crustaceous, foveolate or reticulate; albumen fleshy; cotyledons broad, flat.

Approximately 110 species in the Old World Tropics. Four species in Australia, three endemic.

Key to the Australian and Christmas Island species of *Claoxylon*

1 Leaf laminae linear-lanceolate to elongate-elliptic; 2° veins > 15 per side of 1° vein (midrib); inflorescences up to 40 mm long . . . . . **1. C. angustifolium**
Leaf laminae elliptic, obovate, obovate-oblong or oblanceolate; 2° veins < 12 per side of 1° vein (midrib); inflorescences up to 180 mm long **2**

2 Leaf laminae with pocket domatia at junction of 1° and 2° veins; male flowers 10–15 per glomerule . . . . . **3. C. hillii**
Leaf laminae lacking pocket domatia at junction of 1° and 2° veins; male flowers 1–6 per glomerule **3**

3 Leaf laminae chartaceous . . . . . **4. C. tenerifolium**
Leaf laminae coriaceous **4**

4 Leaf laminae linear-lanceolate to elongate-elliptic; inflorescence bracts glabrous or with scattered indumentum; styles subulate . . . . . **2. C. australe**
Leaf laminae elliptic to ovate; inflorescence bracts with dense indumentum; styles flabellate. . . . . **C. indicum**

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1. Claoxylon angustifolium Müll.Arg., *Linnaea* 34: 165 (1865); *Mercurialis angustifolia* (Müll.Arg.) Baill., *Adansonia* 6: 322 (1866). **Type:** Queensland. South Kennedy District: Port Denison, *E.Fitzalan s.n.* (holo: G-DC *n.v.*, fiche at BRI!; iso: MEL).

Shrub or small tree to 4 m high, evergreen, dioecious, rarely monoecious. Indumentum of simple trichomes, generally antrorse, clear to yellow. Stems rounded, 1.5–2 mm diameter in leaf bearing branchlets, grey, lenticellate, with scattered indumentum when young, glabrescent. Stipules, small, acuminate to subulate, 0.3–0.5 × 0.2–0.3 mm, with sparse indumentum. Leaves: petioles 3–26 × 0.8–1 mm, grooved on top, glabrous, or with scattered indumentum; laminae linear-lanceolate to elongate-elliptic, coriaceous, 40–240 × 4–30 mm, discolorous, 1° and 2° venation weakly developed, 3° and onwards venation ± obscure, 1° venation comprising 16–20 veins per side of midrib; tip acuminate, acute or rounded; base attenuate to cuneate; margins dentate to denticulate, with 11–22 antrorse teeth per side, each tooth up to 0.5 mm long and tipped with an extrafloral nectary and sometimes with a tuft of trichomes; upper surface dark glossy green, 2° onwards venation ± obscure, glabrous or with scattered trichomes when young; lower surface pale blue-green, venation weakly developed, 1° raised below, 2° slightly raised below, 3° and onwards indistinct, glabrous or with sparse indumentum when young, minute pocket domatia absent; extrafloral nectaries 1 or 2 just above lamina base, circular-ellipsoid, shortly stipitate, glabrous. Inflorescences up to 40 mm long, unisexual; peduncle 9–15 mm long, with scattered to sparse indumentum; bracts lanceolate, 0.8–1 × *c.* 0.3 mm, with sparse indumentum. Staminate flowers 1–5 in glomerules, buds umbonate, apiculate; pedicels filiform, 6.5–10 × 0.1–0.2 mm, with scattered indumentum; sepals 3, lanceolate-ovate, 1.5–2.5 × 1.5–2 mm, glabrous; receptacle of narrow, erect glands interspersed with stamens, glabrous; stamens 12–15, filaments 1–1.5 × *c.* 0.2 mm, glabrous, anthers 0.3–0.4 × 0.3–0.4 mm. Pistillate flowers held singly, pedicels filiform, 7–13 × 0.1–0.3 mm, with scattered indumentum; sepals ovate to orbicular, 1.2–1.6 × 0.8–1.8 mm, with scattered indumentum; disk 0.7–0.8 mm long, glabrous; ovaries 1–2 × 1.2–2.2 mm, with dense, adpressed indumentum; styles acute, 0.4–0.5 × 0.2–0.3 mm, not noticeably papillate, glabrous. Fruits depressed-globose, 4–5 × 6–8 mm, green (drying grey-green), with dense adpressed indumentum, rarely glabrescent, sutures of adjacent cocci with a marked groove and with a slight ridge. Seeds with a fleshy red aril, testa 2–3 × 2–3 mm, fawn brown. **Fig. 1.**

***Additional selected specimens examined*: Queensland.** Cook District: Daintree N.P., Adeline Creek Headwaters, Candlenut Scrub, 16°07′S, 145°03′E, May 1999, *Forster PIF24597 & Booth* (BRI); Daintree N.P., Adeline Creek headwaters, top of hill 929, 16°09′S, 145°02′E, May 1999, *Forster PIF24531 & Booth* (BRI, MEL, QRS); S.F.R. 144 Windsor Tableland, Oct 1971, *Hyland 5572* (BRI, QRS); S.F.R. 607 Speerwah, Sep 1959, *Dansie 1907* (BRI); S.F.R. 607, Bridle L.A., Nov 1973, *Hyland 7131* (BRI, QRS); S.F.R. 185, Downfall L.A., Apr 1971, *O'Farrell 18* (BRI, QRS). North Kennedy District: Dryander Creek, middle branch, SE base of Mt Dryander, 20°15′S, 148°34′E, Jun 1989, *Forster PIF5173 & Tucker* (BISH, BRI, MO); Hook Island, Nov 1985, *Batianoff 3612* (BRI); Hill inlet near White Haven Bay, Whitsunday Island, Nov 1985, *Batianoff 3615 & Dalliston* (BRI); Daydream Island, Whitsunday region, 20°15′S, 148°53′E, Apr 1990, *Batianoff 900424* (AD, BRI, MEL); Charley Creek, Woodwark Bay, 20°16′S, 148°39′E, Mar 1994, *Batianoff 9403446* (BRI); Conway Range N.P., 20°17′S, 148°46′E, Apr 1991, *Forster PIF8218* (BRI, K, L, MEL, QRS); Track to Swamp Bay, Conway Range N.P., 20°17′S, 148°47′E, Nov 1985, *Sharpe s.n.* (BRI [AQ423758]); Hayward Creek, Conway N.P., Shute Harbour, *c.* 35 km NE of Proserpine, 20°18′S, 148°45′E, Nov 1985, *Sharpe 4146* (BRI); S.F. 299 Conway, Brandy Creek road, 8 km S of Airlie Beach, 20°20′S, 148°42′E, Feb 2004, *Forster PIF29976 et al.* (A, BRI, L, MEL, NSW, Z); Anderson Bay, Conway N.P., 20°22′S, 148°49′E, May 1994, *Batianoff 9405109 & Dillewaard* (BRI; L *n.v.*). South Kennedy District: S.F. 652 Cathu, 8.5 km along North road, 20°48′S, 148°28′E, Mar 1999, *Forster PIF24189 & Booth* (BRI, MEL); Pease's Lookout, Clarke Range, Eungella N.P., 21°06′S, 148°31′E, Apr 1991, *Forster PIF8055 & McDonald* (BRI, K, L, MEL, MO, QRS); Eungella N.P., Dalrymple road, 21°07′S, 148°30′E, Feb 2004, *Forster*

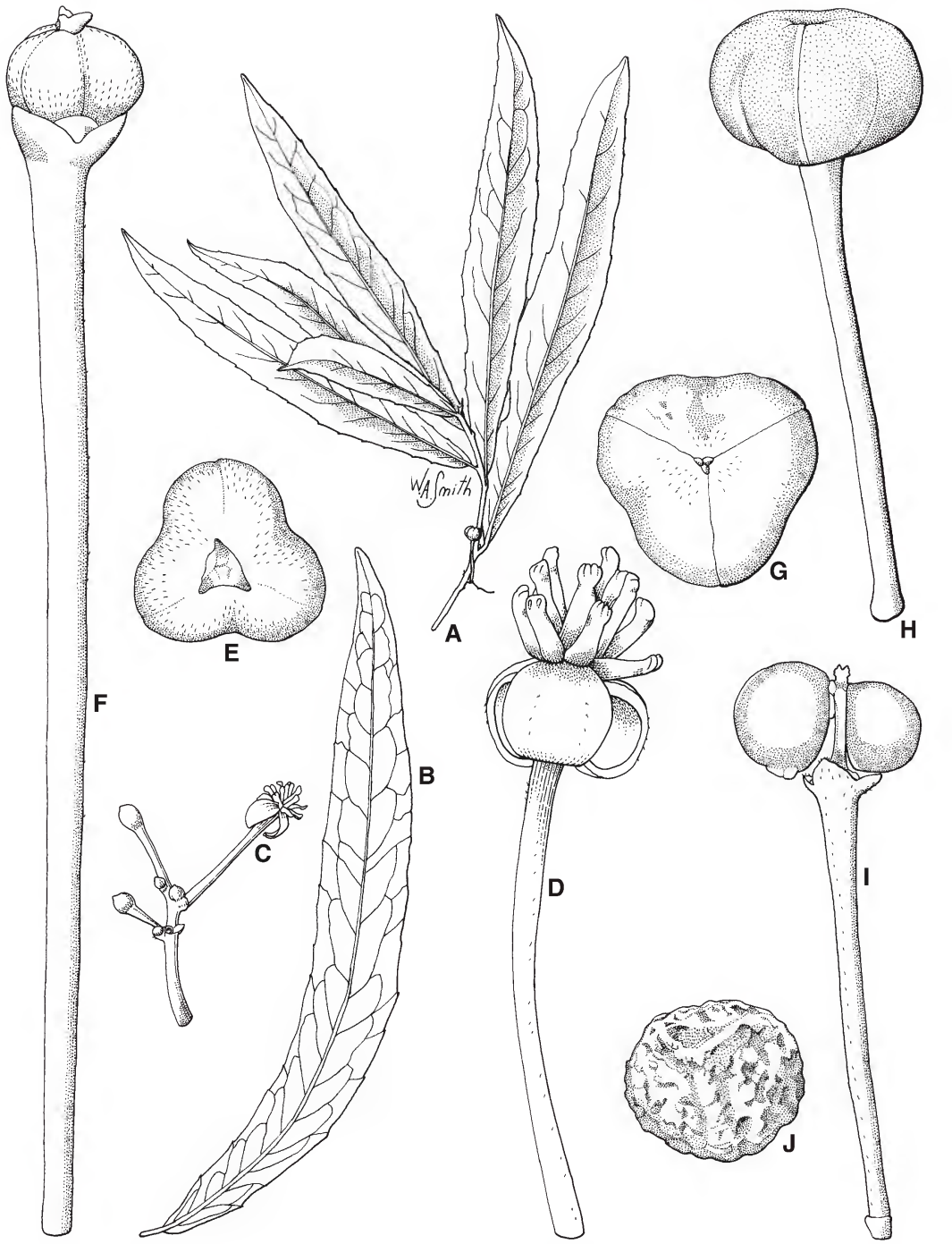

Fig. 1. ***Claoxylon angustifolium.*** A. fruiting branchlet × 0.4. B. leaf viewed from below and showing 1°–2° venation × 0.6. C. inflorescence with male buds and flower × 2. D. lateral view of male flower × 8. E. face view of female flower × 8. F. lateral view of female flower × 6. G. face view of fruit × 4. H. lateral view of fruit × 4. I. lateral view of fruit with dehisced capsule showing two seeds (with arils intact) *in situ* × 4. J. seed with aril removed × 8. A, B, G–J from *Forster PIF29976* (BRI); C & D from *Forster PIF8055* (BRI); E & F from *Forster PIF8092* (BRI). Del. W. Smith.

PIF30056 et al. (BRI); Broken River Walking track, Eungella N.P., 21°10′S, 148°30′E, Apr 1991, *Forster PIF8070 & McDonald* (BRI, K, MEL, QRS).

***Distribution and habitat*:** *Claoxylon angustifolium* is endemic in subcoastal central and north-eastern Queensland where it occurs in four 1° grid squares (**Map 1**). It is the most geographically restricted of the Australian species. The current northern limit is in the Daintree National Park at 16°07′S with the current southern limit at Broken River in Eungella National Park at 21°10′S. Plants grow either in, or on the margins of microphyll to notophyll vineforest, usually on granite substrates at altitudes between 5 and 925 m.

***Notes*:** This species is unique amongst the Australian taxa of *Claoxylon* in the long linear-lanceolate to elongate-elliptic leaf laminae with poorly developed venation and the exceptionally long filiform pedicels.

***Phenology*:** Flowers have been recorded from October to July, fruits from November to August.

***Conservation status*:** This species is widespread and not threatened. Present in Conway, Daintree, Eungella and Whitsunday Islands National Parks and State Forests 144, 185, 299, 432, 607, 652.

***Etymology*:** The specific epithet is derived from the Latin *angustus* (narrow) and *–folius* (leaved).

2. Claoxylon australe Baill., *Etud. Gen. Euph.* 493 (1858); *Mercurialis australis* (Baill.) Baill., *Adansonia* 6: 322 (1866); *Claoxylon australe* var. *australe*: Benth., *Fl. Austral.* 6: 131 (1873). **Type:** Nouvelle Hollande, [1845], [*L.*] *Leichhardt s.n.* (holo: P, *n.v.*; iso: MEL).

Claoxylon australe var. *laxiflora* Benth., *Fl. Austral.* 6: 131 (1873). **Type:** New South Wales, Tweed River, *C. Moore s.n.* (holo: K *n.v.*, photo at BRI!).

Claoxylon australe var. *dentata* Benth., *Fl. Austral.* 6: 131 (1873). **Type:** New South Wales, Macleay River, [*H.*] *Beckler s.n.* (holo: K *n.v.*, photo at BRI!).

***Illustrations*:** Floyd (1989: 140); James & Harden (1990: 407); Hauser (1992: 188); Williams (1999: 115); Logan River Branch S.G.A.P. (Queensland Region) Inc. (2005: 277); Harden *et al.* (2006: 109).

Shrub or small tree to 6 m high, evergreen, usually dioecious, rarely monoecious. Indumentum of simple trichomes, antrorse to divaricate, clear to straw. Stems rounded, 2–3 mm diameter in leaf bearing branchlets, cream, lenticellate, with scattered to dense indumentum when young, glabrescent. Stipules small, acuminate, *c.* 0.5 × 0.3 mm, glabrous or with scattered indumentum. Leaves: petioles 6–40 × 0.5–1 mm, grooved on top, glabrous or with scattered to dense indumentum; laminae cuneate-obovate, elliptic, obovate-oblong, coriaceous, 40–190 × 20–70 mm, discolorous, 1–3° venation strongly developed, 4° and onwards venation indistinct to ± obscure; 1° venation comprising 7–10 veins per side of midrib; tip acute to obtuse; base weakly attenuate to cuneate; margins sinuate to crenulate-dentate, with 12–19 antrorse teeth per side, each tooth up to 0.2 mm long and tipped with an extrafloral nectary; upper leaf surface dark green, glossy, 1° & 2° venation distinct, 3° onwards venation ± obscure, glabrous or with sparse indumentum on veins, soon glabrescent; lower surface pale green, usually drying purple-green or blue-green, 1° & 2° venation well developed and raised, 3° venation distinct but not raised, 4° onwards venation indistinct to ± obscure, glabrous or with scattered to dense indumentum imparting a velutinous texture, minute pocket domatia absent (very rarely one or two per lamina); extrafloral nectaries 2–5 at lamina base, circular, shortly stipitate and glabrous or with scattered indumentum. Inflorescences axillary, up to 90 mm long, usually unisexual, but occasionally with mixed staminate and pistillate flowers; pedunculate up to 15 mm, with scattered to sparse indumentum; bracts triangular-ovate, 0.5–1.4 × 0.4–0.8 mm, glabrous or with scattered indumentum. Staminate flowers 1–6 per glomerule, buds umbonate, apiculate; pedicels filiform, 1.5–4 × 0.4–0.8 mm, glabrous or with scattered to sparse indumentum; sepals (2 or) 3, lanceolate-ovate to ovate, 1.5–3.5 ×

1.4–3 mm, apiculate, glabrous, marginally ciliate or eciliate; receptacle of narrow, erect glands interspersed with stamens, with dense indumentum; stamens 12–40, filaments 1.2–3 × *c.* 0.1 mm, glabrous, anthers 0.4–0.5 × 0.4–0.5 mm. Pistillate flowers held singly, pedicels filiform, 0.5–3 × 0.3–0.8 mm, with scattered indumentum; sepals lanceolate-ovate to orbicular-ovate, 1–2 × 0.5–2 mm, glabrous or with scattered to sparse indumentum; disk annular, 0.2–0.3 mm long, glabrous; ovaries 0.8–1.5 × 1–2 mm, with sparse to dense indumentum; styles subulate, entire, 0.8–1.7 × *c.* 0.1 mm diameter, minutely papillate. Fruits depressed-globose, 3.5–5 × 6–7 mm, green (drying purple-black), with sparse indumentum, suture of adjacent cocci lacking a groove and not prominently ridged. Seeds with an orange to orange-red aril, testa 2.5–3 × 2.5–3 mm, black. *Brittlewood.* **Fig. 2.**

***Additional selected specimens examined*: Queensland.** Port Curtis District: Resumption L.A., S.F. 391 Bulburin, 24°32′S, 151°28′E, Dec 1993, *Forster PIF14534 et al.* (BRI); S.F. 391 Bulburin, Dawes Range road, 24°33′S, 151°29′E, Oct 1999, *Forster PIF24994 & Booth* (A, BRI, L, MEL, QRS); 10 km SSE of Miriamvale, Mt Colosseum N.P., 24°50′S, 151°35′E, Aug 1996, *Thompson MIR286* (BRI). Burnett District: S.F. 695 Kalpowar, Mt Fort William, 4.5 km NE of Kalpowar, 24°39′S, 151°20′E, Jan 2004, *Forster PIF29865 & Tucker* (BRI, L, MEL, NSW); S.F. 695 Kalpowar, 4 km ENE of Kalpowar, 24°41′S, 151°21′E, Jan 2004, *Forster PIF29845 & Tucker* (A, BRI, L, MEL, NSW, Z). Wide Bay District: Great Sandy N.P., Fraser Island, track to Lake Allom, 14 km N of Happy Valley, 25°12′S, 153°12′E, Nov 2002, *Forster PIF29073* & PIF29074** (A, BRI, L, MEL, NSW); Fairlies Knob area, Doongul L.A., S.F. 1294, 25°29′S, 152°17′E, Dec 1992, *Forster PIF12582 & Smyrell* (BRI, MEL, QRS); Oakview, S.F. 220 Malmaison, 13 km ESE of Kilkivan, 26°09′S, 152°19′E, Jan 2003, *Forster PIF29127* (A, L, MEL, NE, NSW). Moreton District: Conondales N.P., start of Peters Fire track, 26°42′S, 152°33′E, Jan 2003, *Forster PIF29220*[+] (A, BRI, L, MEL, NE, NSW); Splityard Creek, Wivenhoe Dam, 27°23′S, 152°38′E, Nov 1990, *Forster PIF7598 et al.* (BRI, K, L, MEL, QRS); S.F. 809, Laceys Creek, D'Aguilar Range, 27°12′S, 152°41′E, Oct 1993, *Forster PIF13987* (A, BRI, K, L, MEL, QRS); Mt Lindesay, 28°20′S, 152°43′E, Nov 1990, *Forster PIF7568 & Orford** (BRI, K, L, MEL, QRS). Darling Downs District: The Head, Main Range N.P., 28°15′S, 152°28′E, Jan 2002, *Forster PIF28072* & Leiper* (A, BRI, L, MEL, NSW); Spring Creek road, 10 km ENE of Killarney, 28°17′S, 152°24′E, Jan 2002, *Forster PIF28076 & Leiper** (A, BRI, L, MEL, NSW). **New South Wales.** Bushrangers Cave track, west of Numinbah Border Gate, Sep 1993, *Forster PIF13864 & Leiper** (A, BRI, K, L, MEL, NSW, QRS); Currowan S.F., 20 km NW of Batemans Bay, 35°32′S, 150°02′E, Dec 1973, *Pullen 8725 & Story** (BRI, CANB); Williams River Valley near Barrington Guest House, N of Singleton, *Pullen 3746** (BRI, CANB, MEL); Wadbilliga N.P., *c.* 0.3 km up unnamed SE running tributary of Brogo River, *Slee 3165** (CANB); Leebold Hill road, Cambewarra Range, NW of Nowra, 34°47′S, 150°33′E, Dec 2000, *Bean 17164** (BRI, NSW); Jervis Bay N.P., 50 m N of 'Lumeah', 35°10′S, 150°35′E, Oct 1996, *Taws 633** (BRI, CANB, NSW). *glabrous variants, [+]intermediate indumentum variants

***Distribution and habitat*:** *Claoxylon australe* is endemic to Australia in subcoastal south-eastern Queensland and eastern New South Wales where it has been recorded from at least twenty-three 1° grid squares (**Map 1**). The most northern locality is from Bulburin Forest Reserve (24°S) and the most southern from Bermagui (37°S). Plants grow in simple to complex microphyll to notophyll vineforests, in the understorey of open forests dominated by eucalypts, or in ecotonal areas, on a variety of substrates, at altitudes between 80 and 1100 m.

***Notes*:** There appears to be strong clinal variation in indumentum cover on the lower leaf laminae and branchlets in this species. Populations at the northern end of the range, particularly those in drier vineforests have densely pubescent foliage with divaricate indumentum. Most collections from higher altitudes in Queensland and New South Wales, or from 'wet' localities such as Fraser Island are glabrous or nearly so. There is an irregular geographical zone of intermediates in southern Queensland at localities such as Buderim Mt (*Forster PIF25975* (BRI)), Tambourine Mt (*Clemens s.n.* [AQ201870]; *Franks AJF9509001*; *White 12725* (all BRI)), near Marburg (*Forster PIF1677* (BRI)), Mt Glorious (*Cribb s.n.* (BRI [AQ478476])) and the Conondales (*Forster PIF28101* (A, BRI, MEL); *Forster PIF29220* (A, BRI, L, MEL, NE, NSW)). The lack of a clear morphological break in this character state negates any move to recognise the pubescent variant as a discrete subspecific taxon which is a prerequisite if the subspecific concept of Stebbins (1950) or Stace (1989) is to be adhered to. There is also considerable variation in the leaf lamina marginal toothing, but this does not seem to be correlated geographically or ecologically, hence there is little purpose in recognising Bentham's varieties.

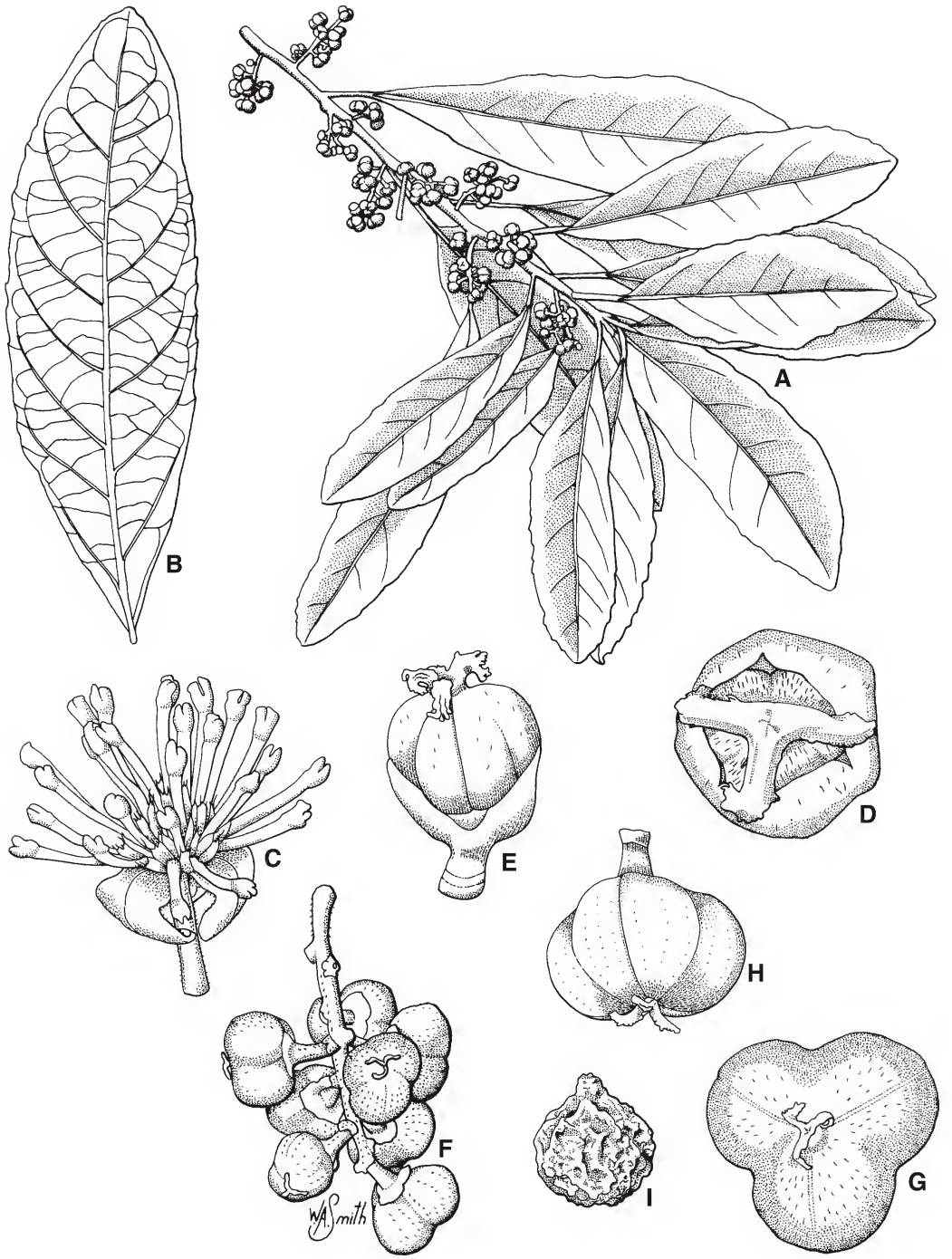

Fig. 2. ***Claoxylon australe.*** A. fruiting branchlet × 0.4. B. leaf viewed from below and showing 1°–3° venation × 0.6. C. lateral view of male flower × 8. D. face view of female flower × 12. E. lateral view of female flower × 8. F. partial inflorescence with fruit × 2. G. face view of fruit × 6. H. lateral view of fruit × 4. I. seed with aril removed × 8. A, B, D, F, G, I from *Forster PIF32433* (BRI); C from *Forster PIF12582* (BRI); E from *Forster PIF7598* (BRI); H from *Forster PIF4882* (BRI). Del. W. Smith.

Claoxylon australe is sometimes confused with *C. tenerifolium*, a situation that is not helped with vague diagnostic descriptions in some field guides (e.g. Harden *et al.* 2006). The fruit are green when ripe, but dry purple-black. Some field guides list the fruit as purple-black (e.g. Harden *et al.* 2006), but this must have been based on examination of dried material rather than fresh material.

***Phenology*:** Flowers August to January, with occasional occurrences in other months. Fruits from November to May.

***Conservation status*:** This species is very widespread and not threatened. It is present in Jervis Bay National Park in the A.C.T., Border Ranges, Dorrigo, Gilbralter Range, Guy Fawkes River, Mimosa Rocks, Mt Warning, Myall Lakes, Wadbilliga, Washpool and Woko National Parks in New South Wales (BRI records; Floyd 1989) and Boat Mountain, Bunya Mountains, Burleigh Head, Conondales, Cressbrook, Great Sandy, Kondalilla, Main Range, Mapleton Falls, Mt Barney, Mt Bauple, Mt Colosseum, Mt Dumeresq, Mt Eerwah, Mt French, Mt Glorious, Mt Mistake, Mt Pinbarren, Wilkie Scrub and Witches Falls National and Conservation Parks in Queensland (BRI records; Forster *et al.* 1991). Present in State Forests 50, 54, 74, 82, 95, 124, 151, 154, 220, 256, 274, 283, 287, 289, 298, 301, 309, 316, 379, 391, 632, 648, 673, 788, 809, 893, 1294, 1344 in Queensland (BRI records; Forster *et al.* 1991) and Bellangry, Clouds Creek, Conglomerate, Currowan, Doyles River, Kangaroo River, Marengo, Moonpar, Mt Pikapene, Oakes, Pine Creek, Toonumbar, Unumgar, Way Way, Whian Whian, Wild Cattle Creek and Yabbra State Forests in New South Wales (BRI records; Floyd 1989).

***Etymology*:** The specific epithet is from the Latin adjective *australis* (south, southern) and refers to this species being the most southerly occurring in Baillon's day, as indeed it is still today.

3. Claoxylon hillii Benth., *Fl. Austral.* 6: 131 (1873). **Type:** Queensland. Cook District: Albany Island, Cape York, *W.Hill 4* (lecto: K *n.v.*, photo at BRI!; *fide* Airy Shaw (1976: 391)).

Claoxylon indicum var. *novoguineense* J.J.Sm., *Meded. Depart. Landb. Ned.-Indië* 10: 26 (1907). **Type:** Indonesia, Papua, Merauke, 1904, *Koch 25* (holo: BO *n.v.*).

Claoxylon delicatum Airy Shaw, *Kew Bull.* 20: 32 (1966). **Type:** Papua New Guinea, Peria Creek, 20 August 1953, *L.J.Brass 24082* (holo: K *n.v.*, photo at BRI!; iso: CANB).

***Illustrations*:** Wheeler (1992: 595, fig. 181E [as *C. tenerifolium*]); Dick (1994: 264 [as *C. tenerifolium*]); Dunlop *et al.* (1995: 211 [as *C. tenerifolium*]); Cooper & Cooper (2004: 176).

Small tree to 15 m high, evergreen, usually dioecious, rarely monoecious. Indumentum of simple trichomes, generally antrorse, clear to straw. Stems rounded, 3–5 mm diameter in leaf bearing branchlets, cream, lenticellate, with dense indumentum when young, glabrescent. Stipules small, acute to subulate, 0.7–1 × 0.2–0.4 mm, glabrous. Leaves: petioles 30–125 × 1.5–2 mm, grooved on top, glabrous; laminae elliptic, obovate or ovate, coriaceous, 95–300 × 40–145 mm, discolorous, 1–3° venation strongly developed, 4° and 5 venation distinct; 1° venation comprising 6–8 veins per side of midrib; tip acute to shortly acuminate, rarely obtuse; base cuneate to rounded; margins sinuate to crenulate-dentate, with 13–40 antrorse teeth per side, each tooth up to 2 mm long and tipped with an extrafloral nectary; upper leaf surface dark green, glossy, 1–3° venation distinct, 4° onwards venation ± obscure, glabrous or with scattered to sparse indumentum on veins, soon glabrescent; lower surface pale green, usually drying dull green or purple-green, 1–5° venation well developed, 1–3° raised, 4° and 5° venation distinct but not raised, glabrous or with scattered to dense indumentum primarily on the 1° and 2° venation, minute pocket domatia between 1° and 2° junctions, particularly towards the lamina base; extrafloral nectaries 1 or 2 at lamina base, subulate, with dense indumentum at base. Inflorescences axillary, up to 180 mm long, usually unisexual, but occasionally with mixed staminate and pistillate flowers; pedunculate up to 17 mm, with sparse to dense indumentum; bracts acuminate to lanceolate, 0.4–1 × 0.3–0.7 mm, with dense indumentum.

Staminate flowers 10–15 per glomerule, buds umbonate, apiculate; pedicels filiform, 1–2.5 × *c.* 0.2 mm, with dense indumentum; sepals 3, lanceolate-ovate, 1.5–1.8 × *c.* 0.8 mm, with dense indumentum; receptacle of narrow, erect glands interspersed with stamens, topped with tufts of trichomes, otherwise glabrous; stamens 16–24, filaments 0.8–1.2 × *c.* 0.1 mm, mainly glabrous apart from dense indumentum at base, anthers 0.3–0.4 × 0.3–0.4 mm. Pistillate flowers held singly or paired, rarely as single flower in male dominated glomerule, pedicels filiform, 1–4 × 0.5–1 mm, with dense indumentum; sepals 3, lanceolate-ovate, 1.8–2.5 × 1.1–1.7 mm, with dense indumentum; disk annular, *c.* 0.5 mm long, somewhat lacerate; styles subulate, 0.7–1 × *c.* 0.1 mm, minutely papillate; ovaries 1.2–2 × 1.2–2 mm, with dense indumentum. Fruits depressed-globose, 6–8 × 3.5–4 mm, green (drying grey-green), with dense indumentum, suture of adjacent cocci prominently ridged. Seeds with an orange-red aril, testa verrucose, *c.* 3 × 3 mm, black. **Fig. 3.**

***Additional selected specimens examined*: Western Australia.** Mitchell Plateau, Lone Dingo, Feb 1979, *Beard 8481* (PERTH). **Northern Territory.** Mt Brockman, Radon Gorge, 12°45′S, 132°54′E, Apr 1980, *Dunlop 5451* (BRI, CANB, DNA, MEL); Grant Island, 11°09′S, 132°52′E, May 1992, *Dunlop 8972* (DNA, MEL); Oxley Island, 10°59′S, 132°49′E, Jul 1992, *Leach 3155* (BRI, DNA); 5 km E of mouth of Peter John River, NE Arnhem Land, 12°15′S, 136°25′E, Feb 1988, *Russell-Smith 4771 & Lucas* (BRI, CANB, DNA, NSW); Conder Point, Melville Island, 11°44′S, 131°17′E, May 1989, *Russell-Smith 8066 & Lucas* (BRI, DNA, PERTH); NE Arnhem Land, Dhalanbuy, 12°15′S, 136°25′E, Feb 1988, *Weightman 4176* (BRI, CANB, DNA). **Queensland.** Cook District: Gabba Island, Torres Strait, 9°45′S, 142°38′E, Jun 2001, *Waterhouse BMW6265* (BRI); Warraba (formerly Sue) Island, Torres Strait, 9°55′S, 142°46′E, Jun 1995, *Waterhouse BMW3669* (BRI, MBA); Albany Island, 10°43′S, 142°35′E, May 1995, *Le Cussan 444* (BRI); Thursday Island, Jun 1897, *Bailey 110* (BRI); Stoney Point, 12°25′S, 143°16′E, Nov 1977, *Tracey 14091* (BRI); opposite the 'Green House', near ranger station, Iron Range, 12°45′S, 143°17′E, Dec 2000, *Legge 20* (BRI, MEL); Iron Range, near King Park, 12°45′S, 143°17′E, Oct 2001, *Legge 30* (BRI); Cairns, suburb of Smithfield, James Cook University Campus, 16°49′S, 145°41′E, Nov 2006, *Forster PIF32314* (BRI, MEL); Currunda Creek, Redlynch, 7 km W of Cairns, 16°55′S, 145°40′E, Dec 2003, *Forster PIF29783 & Jensen* (A, BRI, L, MEL, NSW); Behana Creek (Tringilburra Creek), Bellenden Ker, Jun 1889, *Bailey s.n.* (BRI [AQ201884]); S.F. 310, 10.5 km along Goldsborough road, 17°12′S, 145°45′E, Dec 1993, *Forster PIF14454* (A, BRI, MEL, QRS); McDonnell Creek, behind school, 17°12′S, 145°53′E, Dec 1993, *Forster PIF14450* (A, BRI, K, L, MEL, QRS); Broton Hill, Clump Point N.P., 17°50′S, 146°06′E, Nov 1991, *Halford Q723* (BRI, QRS).

***Distribution and habitat*:** *Claoxylon hillii* is the only non-endemic species of this genus in Australia, as it also occurs in southern New Guinea in both Papua New Guinea and Papua. In Australia it is widespread on northern Cape York Peninsula in Queensland, the 'top end' of the Northern Territory, and the Kimberley of Western Australia. It has been recorded in at least twenty 1° grid cells (**Map 2**). Plants grow in semi-deciduous to deciduous vinethickets and vineforests on a variety of substrates, at altitudes from sea level to 300 m.

***Notes*:** *Claoxylon hillii* was described by Bentham (1873) and subsequently recognised by Bailey (1901), but was reduced to synonymy under *C. tenerifolium,* together with *C. indicum* var. *novoguineense* J.J.Sm. and *C. delicatum* Airy Shaw by Airy Shaw (1976) and this position was subsequently upheld by him (Airy Shaw 1980a,b, 1981). As a result *Claoxylon hillii* has not been recognised in recent local floras or checklists for the regions where it occurs (Wheeler 1992; Dunlop *et al.* 1995; Forster & Henderson 1997; Govaerts *et al.* 2000; Forster & Halford 2002). *Claoxylon hillii* is easily discernible from *C. tenerifolium* in the leaf laminae below with minute pocket domatia between the 1° and 2° veins (versus absent), the subulate extrafloral nectaries (versus stipitate, circular), the greater number of male flowers per glomerule and the densely hairy fruit with marked ridging on the suture between cocci (versus scattered indumentum and no ridging). *Claoxylon hillii* is also a larger growing plant that tends to have thicker branchlets, larger leaves with a greater number of marginal teeth and longer petioles and longer inflorescences.

Claoxylon hillii is superficially similar to *C. indicum*; however, the latter species is easily distinguished by the presence of dense indumentum on the leaf laminae imparting a velutinous quality to the touch.

***Phenology*:** Flowering mainly occurs between September and February, although there are records from June. Fruiting occurs one to two months later.

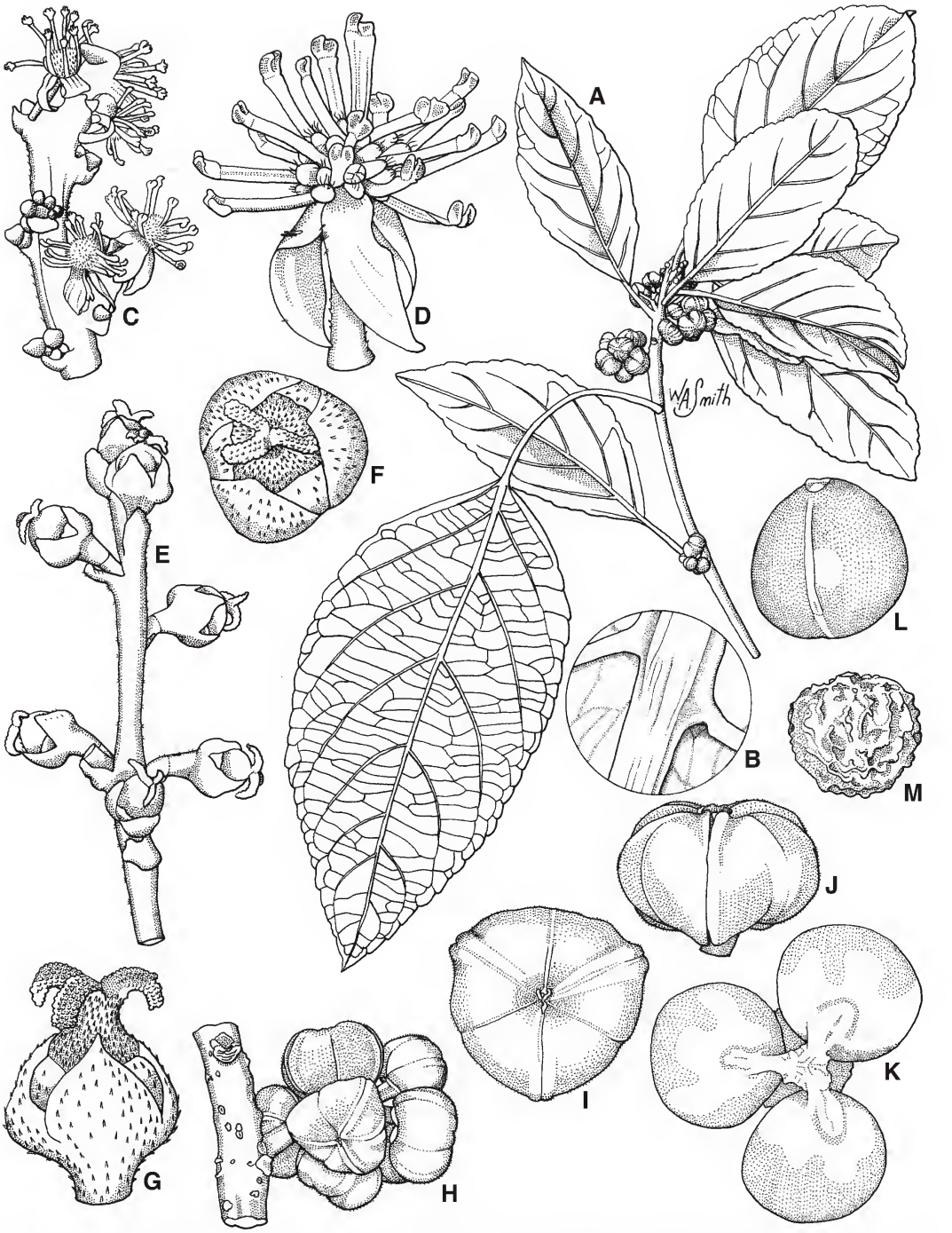

Fig. 3. ***Claoxylon hillii***. A. fruiting branchlet, with one leaf viewed from below and showing 1°–3° venation × 0.4. B. axils of 1° and 2° veins showing poorly formed domatia × 6. C. part of inflorescence with glomerules of male flowers × 3. D. lateral view of male flower × 8. E. part of inflorescence with female flowers × 3. F. face view of female flower × 12. G. lateral view of female flower × 12. H. inflorescence with fruit × 1.5. I. face view of fruit × 3. J. lateral view of fruit × 3. K. face view of fruit with three seeds (arils intact) attached to central columella × 6. L. seed with aril intact × 6. M. seed with aril removed × 6. A, F–J from *Forster PIF32314* (BRI); B–C from *Forster PIF29783* (BRI); K–M from *Legge 20* (BRI). Del. W. Smith.

***Conservation status*:** *Claoxylon hillii* is common and widespread in northern, tropical Australia. It is present in Family Islands, Hinchinbrook, Iron Range and Wooroonooran National Parks, Jumrum Conservation Park and Gadgarra Forest Reserve in Queensland and Kakadu National Park in the Northern Territory.

***Etymology*:** Named for Walter Hill (1820–1904), first Colonial Botanist for the colony of Queensland, and collector of the type.

4. Claoxylon tenerifolium (F.Muell. ex Baill.) F.Muell., *Fragm.* 6: 183 (1868); *Mercurialis tenerifolia* F.Muell. ex Baill., *Adansonia* 6: 323 (1866). **Type:** Queensland. [Port Curtis District:] Rockhampton, Thozet Creek, January 1863, *Dallachy 137* (lecto [here designated]: P *n.v.*, photo at BRI!; isolecto: MEL).

Shrub or small tree to 8 m high, deciduous or evergreen, usually dioecious, rarely monoecious. Indumentum of simple trichomes, generally antrorse, clear to straw. Stems rounded, 2–4 mm diameter in leaf bearing branchlets, cream to grey-yellow, lenticellate, with scattered indumentum when young, glabrescent. Stipules small, acuminate, 0.2–0.7 × 0.1–0.3 mm, with dense indumentum. Leaves: petioles 5–50 × 0.3–1.5 mm, grooved on top, with scattered to dense indumentum; laminae elliptic, obovate or oblanceolate, chartaceous, 18–155 × 8–155 mm, discolorous, 1–3° venation strongly developed, 4° and onwards venation distinct to ± obscure; 1° venation comprising 4–11 veins per side of midrib; tip acute to shortly acuminate; base attenuate to cuneate; margins sinuate to crenulate-dentate, with 8–19 antrorse teeth per side, each tooth up to 2 mm long and tipped with an extrafloral nectary; upper leaf surface dark green, glossy, 1° & 2° venation distinct, 3° onwards venation ± obscure, glabrous or with scattered to sparse indumentum on veins, soon glabrescent; lower surface pale green, usually drying purple-green or blue-green, 1° & 2° venation well developed and raised, 3° venation distinct but not raised, 4° venation distinct to ± indistinct, 5° venation obscure, glabrous or with scattered indumentum primarily on the 1° venation (sometimes on interveinal areas), minute pocket domatia absent; extrafloral nectaries 2 at lamina base, circular, shortly stipitate, with dense indumentum. Inflorescences axillary, up to 130 mm long, usually unisexual, but occasionally with mixed staminate and pistillate flowers; pedunculate up to 10 mm, with scattered to dense indumentum; bracts lanceolate to lanceolate-ovate, 0.8–1.8 × 0.2–0.6 mm, with dense indumentum. Staminate flowers 1–6 per glomerule, buds umbonate, apiculate, pedicels filiform, 0.8–3 × 0.1–0.3 mm, glabrous or with scattered to dense indumentum; sepals 3, lanceolate-ovate, 1.8–2 × 0.7–1.8 mm, glabrous or with scattered indumentum; receptacle of narrow, erect glands interspersed with stamens, glabrous or topped with tufts of trichomes; stamens 10–20, filaments 0.8–1.8 × *c.* 0.1 mm, glabrous, anthers 0.3–0.4 × 0.3–0.4 mm. Pistillate flowers held singly (rarely as single flower in male dominated glomerule), pedicels filiform, 0.5–1.4 × 0.1–0.6 mm, with scattered to dense indumentum; sepals lanceolate-ovate, 0.8–1.2 × 0.5–1 mm, glabrous or with dense indumentum, ciliate on margins; disk annular, 0.3–0.5 mm long, glabrous; styles weakly flabellate, 0.4–0.9 × 0.1–0.3 mm, minutely papillate; ovaries 0.8–1.2 × 0.8–1.2 mm, glabrous or with scattered to dense indumentum. Fruits depressed-globose, 5–7 × 3–4 mm, green-yellow to orange (drying purple-black), glabrous or with scattered indumentum, suture of adjacent cocci lacking a groove and not prominently ridged. Seeds with an orange to orange-red aril, testa verrucose, 2–3 × 2–3 mm, black. *Queensland brittlewood.*

***Notes*:** Baillon (1866) described *Mercurialis tenerifolia* (based on an epithet of Mueller's) citing two syntypes, one collected by Dallachy and the other by Bowman. The better preserved of these two collections is the Dallachy one and it is selected as lectotype of the name.

With the exclusion of *Claoxylon hillii* from synonymy, *C. tenerifolium* remains a variable taxon and two subspecies are recognized here. The nominate subspecies occurs in 'dry rainforest' (vineforests, vinethickets at altitudes below 900 m) in the south of the

species range, whereas the newly described subsp. *boreale* occurs in 'wet rainforest' (vineforests at altitudes above 200 m) in the north of the range. The two subspecies differ primarily in indumentum cover and the dimensions of a number of floral parts. I have not discerned intermediate populations between the two subspecies; however, as the differences are minor, specific rank is not justified. *Claoxylon tenerifolium* subsp. *boreale* also tends to have much glossier foliage in the fresh state than subsp. *tenerifolium*; however, both subspecies have glossy leaves and the glossiness is probably due to local climatic conditions.

***Etymology*:** The specific epithet is derived from the Latin *tener* (tender, delicate) and *–folius* (leaved).

Key to subspecies of *Claoxylon tenerifolium*

Plants evergreen; stipules 0.6–0.7 × *c.* 0.3 mm; male flowers 1–3 per glomerule, pedicels 2.2–3 × 0.2–0.3 mm, with dense indumentum; receptacle glands topped with tufts of trichomes, otherwise glabrous; female flowers with pedicels 0.8–2.2 × 0.4–0.6 mm, with dense indumentum, sepals and ovaries with dense indumentum; Wet Tropics of Queensland . . . . . **subsp. *boreale***

Plants evergreen to deciduous; stipules *c.* 0.2 × 0.1 mm; male flowers 1–6 per glomerule, pedicels 0.8–2.5 × *c.* 0.1 mm, glabrous or with scattered indumentum; receptacle glands glabrous; female flowers with pedicels 0.5–1.4 × 0.1–0.2 mm, with scattered to sparse indumentum, sepals glabrous, ovaries glabrous or with scattered indumentum near base; Queensland, mainly south of the Wet Tropics . . . . . **subsp. *tenerifolium***

4a. *Claoxylon tenerifolium* subsp. ***tenerifolium***

Claoxylon australe var. *latifolia* Benth., *Fl. Austral.* 6: 131 (1873). **Type:** Queensland. [Port Curtis District:] Rockhampton, *O'Shanesy s.n.* (holo: K *n.v.*, photo at BRI!).

***Illustrations*:** Williams (1999: 115); Harden *et al.* (2006: 109).

Evergreen to deciduous shrub or small tree to 6 m tall. Stipules *c.* 0.2 × 0.1 mm. Leaf petioles 5–50 × 0.3–1.5 mm, with scattered indumentum. Inflorescences up to 80 mm long. Staminate flowers 1–6 per glomerule, pedicels 0.8–2.5 × *c.* 0.1 mm, glabrous or with scattered indumentum; receptacle glands glabrous. Pistillate flowers with pedicels 0.5–1.4 × 0.1–0.2 mm, with scattered to sparse indumentum; sepals glabrous; ovaries glabrous or with scattered indumentum near base, rarely near apex; styles 0.4–0.5 × *c.* 0.1 mm. Fruits 6–7 × 3.5–4 mm. Seeds 2.5–3 × 2.5–3 mm. **Fig. 4.**

***Additional selected specimens examined*: Queensland.** North Kennedy District: 40 Mile Scrub, 18°05′S, 144°49′E, Jan 2005, *Sankowsky 2579 & Sankowsky* (BRI); Mingela Bluff, 19°53′S, 146°45′E, Jan 1992, *Forster PIF9425 & Bean* (BRI, K, MEL, QRS); Mt Abbot, 50 km W of Bowen, 20°06′S, 147°46′E, Oct 1992, *Bean 5178* (BRI); 14 km E of Mt Cooper Homestead, 20°31′S, 146°55′E, Jun 1992, *Thompson GHA45 & Sharpe* (BRI). South Kennedy District: Carlisle Island, 35 km N of Mackay, 20°47′S, 149°17′E, Dec 1986, *Sharpe 4600* (BRI); 9 km W of Cathu, Cathu S.F., 20°48′S, 148°33′E, Dec 1991, *Halford Q825* (BRI); Hazlewood Gorge, SSW of Eungella, 21°15′S, 148°27′E, Jan 1993, *Forster PIF12722* (BRI). Leichhardt District: 'Clive', 22°47′S, 149°24′E, Mar 1993, *Fensham 740* (BRI); 26 km NE of Taroom, Mt Rose Station, 25°27′S, 149°58′E, Nov 1996, *Halford Q3197* (BRI). Port Curtis District: S.F. 114, 65 km NW of Rockhampton, 23°06′S, 150°01′E, Dec 1998, *Batianoff GNB981238 et al.* (AD, BRI, DNA, NSW); Dan Dan Scrub, S.F. 53, 24°10′S, 151°04′E, Dec 1987, *Gibson 1054* (BRI); S.F. 583 Wietalaba, 24°17′S, 151°12′E, Dec 1995, *Forster PIF18271* (BRI); Deepwater N.P., 40 km E of Miriam Vale, 24°21′S, 151°58′E, Dec 1990,

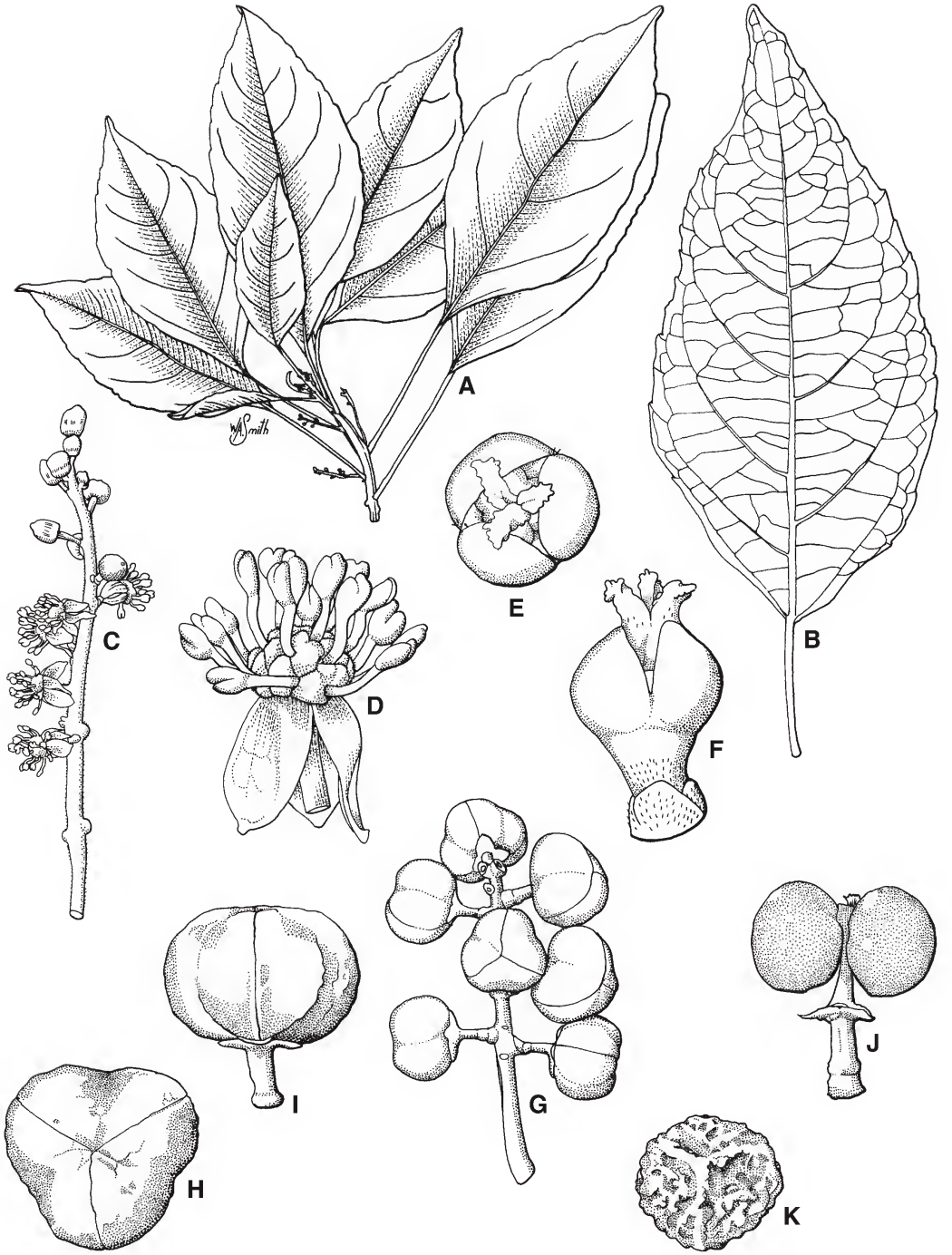

Fig. 4. ***Claoxylon tenerifolium*** **subsp.** ***tenerifolium***. A. flowering branchlet × 0.4. B. leaf viewed from below showing 1°–3° venation × 1. C. part of inflorescence with glomerules of male flowers × 2. D. lateral view of male flower × 8. E. face view of female flower × 12. F. lateral view of female flower × 12. G. part of inflorescence with fruit × 2. H. face view of fruit × 4. I. lateral view of fruit × 4. J. dehisced fruit with two seeds in situ with arils intact × 4. K. seed with aril removed × 8. A from *Forster PIF6187* (BRI); B, H–J from *Forster PIF29900* (BRI); C & D from *Forster PIF12585* (BRI); E & F from *Forster PIF12591* (BRI). Del. W. Smith.

Gibson TOI81 (BRI). Burnett District: Goodnight Scrub National Park, 25°17′S, 151°52′E, Jan 2004, *Forster PIF29900 & Tucker* (A, BRI, L, MEL, MO, NSW, Z); 3.5 km SSE of Binjour, 25°33′S, 151°28′E, Jan 1990, *Forster PIF6187* (BISH, BRI, DNA, MEL, MO, QRS); Coast Range, Coongara Creek, 19 km SSW of Biggenden, 25°14′S, 151°59′E, Nov 1993, *Telford 11961* (BRI, CANB). Wide Bay District: Mt Gaeta, *c.* 36 km N of Mt Perry township, 24°50′S, 151°35′E, Oct 1993, *Forster PIF14166* (BRI); Fairlies Knob area, Doongul L.A., S.F. 1294 Warrah, 25°29′S, 152°17′E, Dec 1992, *Forster PIF12585 & Smyrell* (BRI, QRS); Utopia, 14 km SSE of Biggenden, 25°38′S, 152°05′E, Dec 1991, *Forster PIF9224 & Smyrell* (A, BRI, K, L, MEL, QRS); S.F. 420, 25°55′S, 152°23′E, Nov 1988, *Forster PIF4843* (BRI, NSW).

***Distribution and habitat*:** *Claoxylon tenerifolium* subsp. *tenerifolium* occurs in eastern subcoastal Queensland from Forty Mile Scrub N.P. in the north (18°05′S) to State Forest 420 in the south (25°54′S) and has been recorded from at least nineteen 1° grid squares (**Map 3**). Plants grow in 'dry rainforests' (simple to complex microphyll and notophyll vineforests and vinethickets) on a variety of soils derived from basalts, granites and sandstones at altitudes from near sealevel to 900 m (the latter in inland locations such as the Central Highlands).

***Notes*:** Both *Claxylon australe* and *C. tenerifolium* subsp. *tenerifolium* may be sympatric where the ranges of the two intersect (e.g. *Forster PIF12585 & PIF12582*) but no hybrids have been observed.

The fruits are yellow-green to orange when ripe, but dry purple-black. Some field guides list the fruit as purple-black (e.g. Harden *et al.* 2006), but this must have been based on examination of dried collections rather than fresh material.

***Phenology*:** Flowers and fruits throughout the year, although the main flowering period is from October to December.

***Conservation status*:** *Claoxylon tenerifolium* subsp. *tenerifolium* is common and widespread. It has been recorded from Forty Mile Scrub, Deep Water, Goodnight Scrub, Mt Walsh and Palmgrove National Parks and State Forests 42, 53, 310, 391, 420, 1229, 1294 (BRI records; Forster *et al.* 1991).

4b. Claoxylon tenerifolium subsp. **boreale** P.I.Forst., **subspecies nova**, a *C. tenerifolio* subsp. *tenerifolio* stipulis grandioribus (0.6–0.7 × *c.* 3 mm in vicem 0.2 × *c.* 0.1 mm), floribus masculis in quoque glomerulo paucioribus (1–3 in vicem 1–6), in pedicellis crassis (2.2–3 × 0.2–0.3 mm in vicem 0.8–2.5 × *c.* 0.1 mm) dispositis, indumento denso (in vicem dispersi usque sparsi), summis glandulis receptaculi crinibus trichomatum ornatis, cetera glabris (in vicem glaberrimorum), floribus femineis in pedicellis crassis (2.2 × 0.4–0.6 mm in vicem 0.5–1.4 × 0.1–0.2 mm) dispositis, indumento denso (in vicem dispersi usque sparsi), sepalis ovariisque indumento denso (in vicem dispersi vel carentis) praeditis differt. **Typus:** Queensland. Cook District: State Forest 143, South Mary Logging Area, 21 km along Mt Lewis road, 16°32′S, 145°16′E, 1 November 2001, *P.I.Forster PIF27700*, *R.Booth & R.Jensen* (holo: BRI [2 sheets & spirit]; iso: A, BISH, DNA, L, MEL, MO, NSW, Z).

Evergreen shrub or small tree to 8 m tall. Stipules 0.6–0.7 × *c.* 0.3 mm. Leaf petioles 13–38 × 0.8–1 mm, with scattered to dense indumentum. Inflorescences up to 130 mm long. Staminate flowers 1–3 per glomerule, pedicels 2.2–3 × 0.2–0.3 mm, with dense indumentum; receptacle glands topped with tufts of trichomes, otherwise glabrous. Pistillate flowers with pedicels 0.8–2.2 × 0.4–0.6 mm, with dense indumentum; ovaries with dense indumentum; styles 0.5–0.9 × 0.2–0.3 mm. Fruits 5–6 × 3–4 mm. Seeds 2–2.2 × 2–2.8 mm. **Fig. 5.**

***Additional selected specimens examined*: Queensland.** Cook District: T.R. 55, Whyanbeel, 16°20′S, 145°20′E, Oct 1974, *Hyland 7743* (BRI, QRS); S.F. 143, North Mary L.A., 16°30′S, 145°16′E, Nov 1995, *Forster PIF18120 et al.* (BRI); Mt Lewis road, 26 km from junction with Mareeba – Mossman road, 16°31′S, 145°16′E, Oct 1987, *Foreman 1871* (BRI, CANB, MEL, NSW, QRS); S.F. 143, North Mary L.A., 29 km along Mt Lewis road near hut, 16°31′S, 145°16′E, Jul 1994, *Forster PIF15635 et al.* (BRI, QRS); S.F. 143, South Mary L.A., 21 km along Mt Lewis road, 16°32′S, 145°16′E, Nov 2001, *Forster PIF27699 et al.* (A, BISH, BRI, DNA, L, MEL, MO, NSW, Z); Mt Lewis, just beyond North Mary Creek, 16°33′S, 145°17′E, Nov 1998, *Jensen 939* (BRI, QRS); S.F. 42 Mowbray, Rex Range, 16°32′S, 145°22′E, Dec 2001, *Forster PIF27909 et al.* (A, BISH, BRI, L, MEL, MO, NSW, NY, Z); S.F. 1229 Kuranda, 14 km along Black Mt road from Kuranda road, 16°45′S, 145°34′E, Sep 2001, *Forster PIF27529 et al.* (A, BRI, L, MEL, NSW, NY); Black Mt road, N of Kuranda, 16°48′S, 145°38′E,

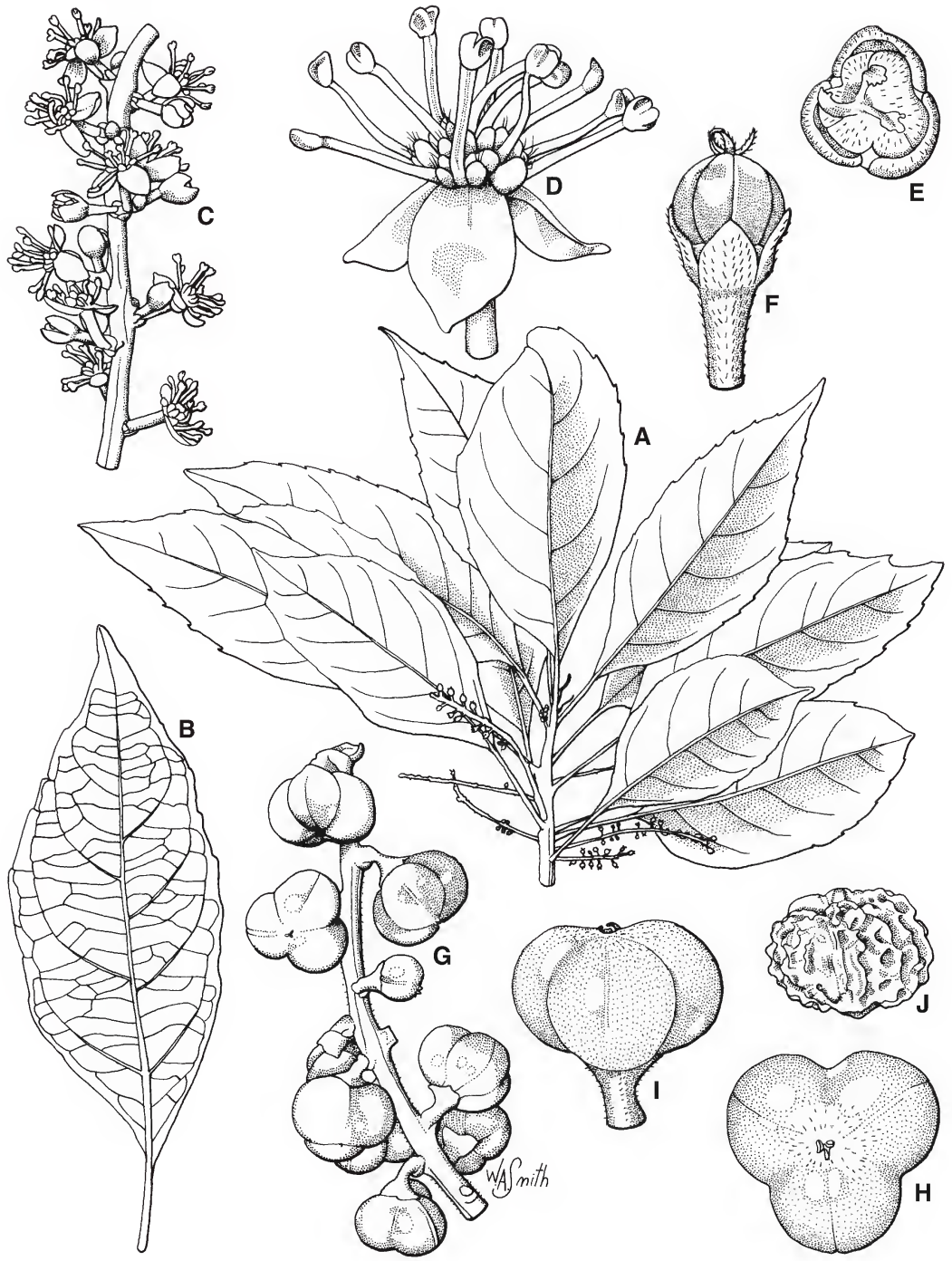

Fig. 5. ***Claoxylon tenerifolium*** **subsp.** ***boreale***. A. flowering branchlet × 0.6. B. leaf viewed from below showing 1°–3° venation × 1. C. part of inflorescence with glomerules of male flowers × 2. D. lateral view of male flower × 8. E. face view of female flower × 12. F. lateral view of female flower × 8. G. part of inflorescence with fruit × 2. H. face view of fruit × 4. I. Lateral view of fruit × 4. J. seed with aril rermoved × 8. A, B, E, F from *Forster PIF27699* (BRI); C & D from *Forster PIF27700* (BRI); G–J from *Forster PIF29767* (BRI). Del. W. Smith.

Dec 2001, *Jago 5819* (BRI); North Bell Peak, summit area, Malbon Thompson Range, 17°05′S, 145°52′E, Nov 1995, *Forster PIF18044 et al.* (BRI); S.F.R. 194, 17°20′S, 145°25′E, Feb 1969, *Hyland 2156* (BRI); Wooroonooran N.P., track to Bartle Frere from west, 17°22′S, 145°45′E, Dec 2003, *Forster PIF29761 & Jensen* (BRI, L); lower slopes of Mt Bartle Frere, 17°22′S, 145°47′E, Dec 1994, *Hunter JH1628* (BRI); Westcott road, Topaz, 17°24′S, 145°42′E, Nov 1995, *Forster PIF18188* (BRI, K, MEL, NSW, QRS); *loc. cit.*, Nov 2002, *Cooper WWC1797, WWC1799* (BRI); *loc. cit.*, Dec 2003, *Forster PIF29767 & Jensen* (A, BRI, L, MEL, NSW).

***Distribution and habitat*:** *Claoxylon tenerifolium* subsp. *boreale* is endemic to the Wet Tropics of north-eastern Queensland and has been recorded from two 1° grid squares (**Map 3**). Plants grow on the margins of 'wet rainforest' (simple to complex notophyll vineforest or microphyll moss/fern thicket) on substrates derived from basalts, granites or metamorphics at altitudes between 200 and 1200 m.

***Notes*:** This subspecies shows some variation in leaf lamina shape and thickness, mainly associated with elevation and exposure. The populations on the Mt Lewis road (altitude above 1000 m) tend to have elliptic laminae that are somewhat thicker, whereas those in more lowland localities (e.g. Black Mt road, Whyanbeel, Rex Range) have obovate to oblanceolate laminae that are thinner. These differences are probably phenotypic; however, transplant experiments are required to determine this.

***Phenology*:** Flowers have been recorded from October to November. Fruiting would be one to two months later.

***Conservation status*:** This subspecies is of sporadic and somewhat restricted distribution. It appears to be a pioneer species that requires areas of disturbance and is often collected on the margins of rainforest or on roadsides through rainforest. It is not considered threatened and is present in the conservation estate at Malbon Thompson, Mowbray and Mt Lewis Forest Reserves and Wooroonooran National Park.

***Etymology*:** The subspecific epithet is based on the Latin word *borealis* (north, northern) and pertains to the distribution of the taxon.

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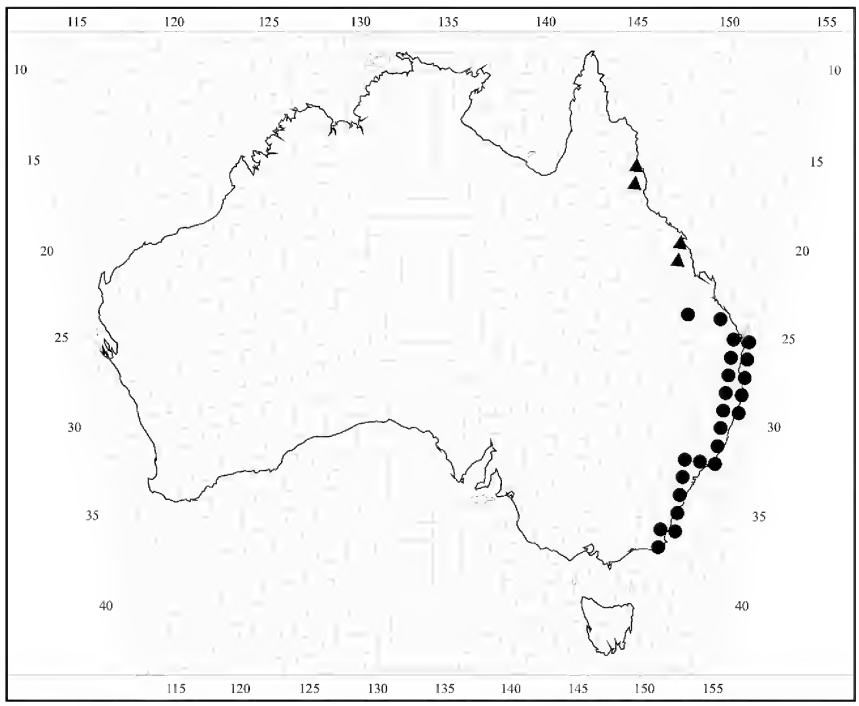
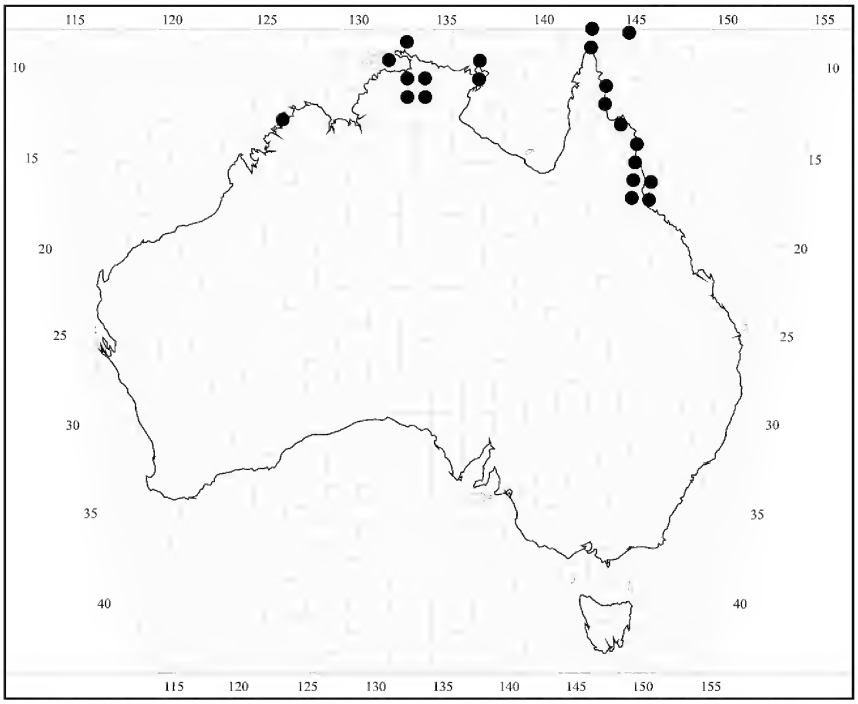
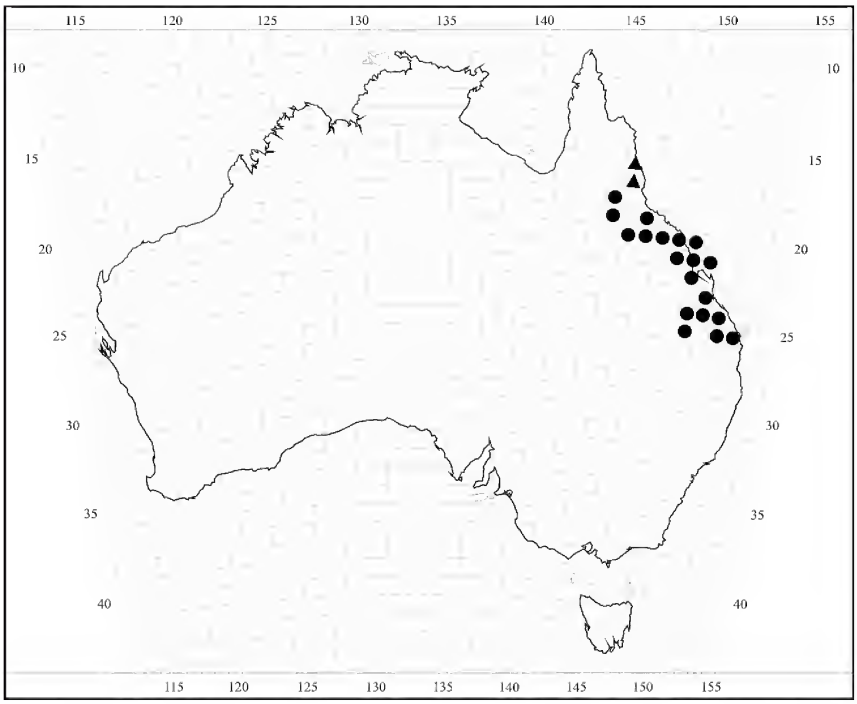


Map 1. Distribution in 1° grids in Australia for *Claoxylon angustifolium*▲ and *Claoxylon australe* ●.



Map 2. Distribution in 1° grids in Australia for *Claoxylon hillii* ●.



Map 3. Distribution in 1° grids in Australia for *Claoxylon tenerifolium* subsp. *tenerifolium* ● *and Claoxylon tenerifolium* subsp. *boreale* ▲.

A taxonomic revision of the genus *Zieria* Sm. (Rutaceae) in Queensland

Marco F. Duretto[1] & Paul I. Forster[2]

Summary

Duretto, M.F. & Forster, P.I. (2007). A taxonomic revision of the genus *Zieria* Sm. (Rutaceae) in Queensland. *Austrobaileya* 7(3): 473–544. A taxonomic revision of the genus *Zieria* Sm. in Queensland is presented with thirty-five species recognised. Sixteen new species are described and illustrated: *Z. actites* Duretto & P.I.Forst., *Z. alata* Duretto & P.I.Forst., *Z. bifida* Duretto & P.I.Forst., *Z. boolbunda* Duretto & P.I.Forst., *Z. cephalophila* Duretto & P.I.Forst., *Z. distans* Duretto & P.I.Forst., *Z. eungellaensis* Duretto & P.I.Forst., *Z. exsul* Duretto & P.I.Forst., *Z. graniticola* J.A.Armstr. ex Duretto & P.I.Forst., *Z. hydroscopica* Duretto & P.I.Forst., *Z. inexpectata* Duretto & P.I.Forst., *Z. insularis* Duretto & P.I.Forst., *Z. madida* Duretto & P.I.Forst., *Z. scopulus* Duretto & P.I.Forst., *Z. tenuis* Duretto & P.I.Forst. and *Z. vagans* Duretto & P.I.Forst. *Z. whitei* J.A.Armstr. ex Duretto & P.I.Forst. (based on *Z. aspalathoides* var. *intermedia* C.T.White) is newly recognised at specific rank and illustrated. *Z. compacta* C.T.White is reinstated at species level. *Z. fraseri* subsp. *robusta* (C.T.White) Duretto & P.I.Forst. is newly recognised at subspecific rank. An assessment is provided of the current conservation status for all *Zieria* taxa found in Queensland with occurrence in conservation reserves noted. New distributional information is given for various taxa. Keys to all taxa of *Zieria* found in Queensland are provided.

Key Words: Rutaceae, *Zieria*, *Zieria actites*, *Zieria alata*, *Zieria bifida*, *Zieria boolbunda*, *Zieria cephalophila*, *Zieria compacta*, *Zieria distans*, *Zieria eungellaensis*, *Zieria exsul*, *Zieria fraseri* subsp. *robusta*, *Zieria graniticola*, *Zieria hydroscopica*, *Zieria inexpectata*, *Zieria insularis*, *Zieria madida*, *Zieria scopulus*, *Zieria tenuis*, *Zieria vagans*, *Zieria whitei*, Australian flora, Queensland flora, new species, identification keys, conservation status codings

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Introduction

The genus *Zieria* Sm. is restricted to eastern Australia (Queensland, New South Wales, Victoria, South Australia and Tasmania) with the exception of one species, *Z. chevalieri* Virot, which is endemic to New Caledonia. A monograph of the genus was undertaken by Armstrong (1991a) and formally published (Armstrong 2002), with little subsequent updating, to recognise some 42 species and 16 subspecies (including typical subspecies). In his monograph Armstrong recognised 16 species and 12 subspecies of *Zieria* for the state of Queensland.

Much of the work presented in Armstrong's publication is based on collections incorporated into herbaria prior to around 1987, indeed many of his determinations on specimens at BRI date from the 1970s to 1982, with only a few further determinations through to 1992. There are now considerable additional specimens in herbaria such as BRI that have active collection programs. Some of these specimens do not belong to the taxa recognised by Armstrong (1991a, 2002) and have been given informal phrase names at BRI (e.g. in Forster 1997b, 2002, 2007). All of these new taxa are formally named in this paper. As well, we change the application of several names (e.g. *Z. fraseri*, *Z. robertsiorum*, *Z. montana*) and resurrect one taxon (*Z. compacta*) relegated by Armstrong to subspecific rank. Here we recognise 35 (23 endemic) species and ten (five endemic) subspecies of *Zieria* for Queensland. In total, *Zieria* contains 61 species and 16 subspecies.

Most of the previously undescribed taxa are relatively restricted in occurrence and either have or require conservation codings under Queensland legislation. Armstrong

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(2002) made many pronouncements on the conservation status of Queensland taxa of *Zieria,* although these were not necessarily in accordance with the way the taxa have been listed under Queensland legislation. Many of these pronouncements are incorrect in the light of herbarium collections over the last 20 years, and an up to date assessment of conservation status based on the IUCN criteria (IUCN 2001) of all Queensland taxa of *Zieria* is included here together with current or pending listings under the Queensland *Nature Conservation (Wildlife) Regulation* 2006 (*NCR* 2006).

Speciation Patterns

Speciation patterns in *Zieria* are complex, undoubtedly reflecting the evolutionary and climatic histories of the localities where they occur now and have in the past. Although Armstrong (2002) provided a morphologically based species phylogeny for the species of *Zieria* that he recognised, including the delimitation of species groups, it is likely that this is invalid in the light of the additional taxa now recognised.

The closest equivalent to *Zieria* in species distribution patterns may be found in the genus *Plectranthus* L.Her. (Lamiaceae) where there is a group of wide ranging taxa in conjunction with putatively recently evolved, narrowly distributed entities (Forster 1994a, 1997a). Narrowly distributed species of both *Plectranthus* and *Zieria* are often found on small isolated islands of rocky substrates (usually granite, rhyolite, sandstone, trachyte) surrounded by rainforest or more fire prone habitats. In these habitats, plants of *Zieria* may be narrowly distributed in clefts or crevices where little vegetation can establish or persist. Consequently many species of *Zieria* have populations that are small in size and prone to extinction due to disturbance (especially fire) (Fitzsimmons 1999), climate change (especially prolonged drought), genetic depauperation (Hogbin & Peakall 1999; Sharma 2001), weed infestation or other environmental variables.

Many species of both genera occur on inselbergs (isolated mountains), renowned worldwide for increased speciation rates in the taxa that are present (Porembski & Barthlott 2000; Burke 2003) driven by an 'islands on islands' effect (Porembski *et al.* 1997, 2000). The combination of population isolation, variable population sizes and the ability to colonise new habitats may well have driven speciation in these two genera. The varied range of microhabitats and edaphic conditions on inselbergs and other mountains in Queensland has provided numerous niches into which taxa of both *Plectranthus* and *Zieria* have speciated. Examples of *Zieria* species from Queensland that occur in rocky habitats (clefts and crevices on pavements and outcrops) on isolated mountains include *Z. actites, Z. alata*, *Z. boolbunda*, *Z. cephalophila*, *Z. compacta*, *Z. eungellaensis*, *Z. fraseri* subsp. *fraseri*, *Z. madida*, *Z. montana*, *Z. rimulosa*, *Z. robertsiorum* and *Z. scopulus.* Whether these mountainous habitats have acted as refugia for these species over time in the face of changing regional climates, or these species are recent autochthonous elements is unknown. However, unlike the situation in *Plectranthus* where plants are invariably found in open, rocky situations, many species of *Zieria* occur in the understorey of open forest and woodland. These forested habitats are often immediately adjacent to the rocky habitats, hence the possibility that allopatric speciation has occurred from species of these habitats into the rocky habitats is high, and vice versa. These patterns of allopatric speciation are thought to be responsible for the high diversity associated with the sparse vegetation on granite outcrops and adjacent, more developed vegetation in south-west Western Australia (Hopper *et al.* 1997).

Zieria and *Plectranthus* taxa provide unique examples of species radiation in changing environments with 'core' species in the more widespread (and possibly stable?) habitats and 'refuge-endemics' or 'neo-endemics' in restricted refugial habitats (most montane species) and newly available or transitory habitats such as ecotonal areas (e.g. *Z. bifida*, *Z. collina*). Many species from both genera (particularly *Plectranthus*) fit the 'obligate-seeder' model of Clarke (2002a,b), i.e. they are killed in fires and have to regenerate from seed. Evidence of

resprouting by *Zieria* species after fire is equivocal (Auld 2001; Benson & McDougall 2001) and may be dependent on the presence of lignotubers (*cf.* Armstrong 1991a; Fitzsimmons 1999), a feature that is poorly documented for nearly all taxa. The species that occur in the open, rocky habitats are subjected to lower fire frequencies due to the inability of the vegetation cover to regularly sustain fire, so fit the 'refuge-endemic' model. Several species in this habitat type are known to resprout after fire (Auld 2001; Benson & McDougall 2001). Some species that occur in fire prone vegetation away from rock outcrops (e.g. *Z. collina*, *Z. laevigata*, *Z. smithii*, *Z. southwellii*) do not appear to possess lignotubers (Auld 2001; Fitzsimmons 1999) and may well be predominantly 'obligate-seeders'.

The two genera are also examples of 'non-adaptive radiation' accompanied by a 'high lineage diversification rate' with broad similarities to examples from the animal kingdom (e.g. *Albinaria* snails) where there are a lot of species that are similar in general morphology and habitat preferences but that occur in disjunct localities (Savolainen & Forest 2005).

In Queensland (Qld) the wide-ranging taxa (> five 1° grid cells of distribution) are *Zieria arborescens* subsp. *arborescens* (distributed mainly in New South Wales (NSW)), *Z. compacta*, *Z. cytisoides*, *Z. laevigata*, *Z. laxiflora* and *Z. smithii*. Taxa with a moderate distribution (2–5 1° grid cells; *in sense previously recognised by Armstrong 2002) are *Z. distans*, *Z. fraseri* subsp. *robusta*, **Z. furfuracea* subsp. *euthadenia*, *Z. inexpectata*, **Z. minutiflora* subsp. *minutiflora*, **Z. minutiflora* subsp. *trichocarpa*, *Z. robertsiorum*, **Z. southwellii* (distributed mainly in NSW), *Z. tenuis* and **Z. verrucosa*. Narrow-endemics (restricted to a single 1° grid cell but with more than one population; *in sense previously recognised by Armstrong 2002) are **Z. adenodonta*, *Z. alata*, **Z. arborescens* subsp. *glabrifolia*, **Z. aspalathoides* subsp. *brachyphylla*, *Z. bifida*, **Z. collina*, *Z. eungellaensis*, *Z. exsul*, *Z. fraseri* subsp. *fraseri*, **Z. furfuracea* subsp. *gymnocarpa*, *Z. graniticola*, *Z. insularis*, *Z. madida*, *Z. montana*, **Z. obovata*, **Z. rimulosa*, *Z. scopulus*, *Z. tenuis*, *Z. vagans* and *Z. whitei*. The newly described species *Z. actites*, *Z. boolbunda*, *Z. cephalophila* and *Z. hydroscopica* are currently known from single localities. It is worth noting that species of *Zieria* that are endemic to NSW and previously recognised by Armstrong (2002), *viz. Z. adenophora* Blakely, *Z. baeuerlenii* J.A.Armstr., *Z. granulata* C.Moore ex Benth., *Z. hindii* J.A.Armstr., *Z. ingramii* J.A.Armstr., *Z. lasiocaulis* J.A.Armstr. and *Z. prostrata* J.A.Armstr. are restricted to single 1° grid cells, and that *Z. buxijugum* J.D.Briggs & J.A.Armstr., *Z. covenyi* J.A.Armstr., *Z. floydii* J.A.Armstr., *Z. formosa* J.A.Armstr. and *Z. parrisiae* J.A.Armstr. are known from single populations. Hence, this proposed speciation pattern of a 'core' group of widespread species and relatively many narrowly distributed species, is prevalent throughout the geographic range of the genus in eastern Australia.

Materials and methods

This paper is primarily based on herbarium collections in BRI, HO, MEL and QRS, though specimens from CANB, NE and NSW have also been seen, and field collections and observations made mainly by the second author. Where we have listed additional collections for taxa recognised by Armstrong (2002), these are generally relatively recent (therefore the populations are probably still extant) and in addition to those cited, annotated, or listed in his list of exsiccatae, or add substantially to the distributional range known for the taxon as mapped in the 2002 monograph. We have especially cited material from National Parks or other conservation reserves to reinforce our statements on conservation status and to demonstrate which species are presently conserved. For species that also occur outside of Qld, we have generally not cited material except in instances where significant new distributional data is available (e.g. *Z. arborescens, Z. southwellii*).

For consistency, our descriptions are modelled on those of Armstrong. Minor notes about the descriptions are as follows –

(1) if an organ can be wholly described in terms of its indumentum cover, then this is made only once. Where parts of an organ differ in indumentum cover than this is separately described, e.g. gynoecium only versus separate ovary and style descriptions.

(2) length by width descriptions for organs are indicated as 'number × number' followed by the common measurement in mm.

In the following taxonomic treatment, species are listed alphabetically. All descriptions are based on collections made in Qld. All newly described taxa are endemic to Qld. New descriptions of some previously recognised taxa, e.g. *Z. compacta*, *Z. fraseri*, *Z. montana* and *Z. robertsiorum*, are given where the circumscription of these taxa differ somewhat from that of Armstrong (2002).

Species and subspecies are defined as previously outlined and applied in the Rutaceous genera *Boronia* (Duretto 1997, 1999a, 1999b, 2003; Duretto & Ladiges 1997), *Phebalium* (Forster 2003) and *Philotheca* (Forster 2005).

Common abbreviations in the specimen citations are L.A. (Logging Area), N.P. (National Park), S.F. or S.F.R. (State Forest Reserve). Cited specimens are arranged north to south within Queensland Pastoral Districts. Bioregion nomenclature is per Sattler & Williams (1999).

Taxonomy

Key to the species of *Zieria* found in Queensland

1. Leaves prominently glandular verrucose, if only on abaxial surface or margins or midrib 2
   Leaves not prominently glandular verrucose 12

2. Terminal leaflets elliptic to lanceolate, 1.5–15 mm wide, margins flat to slightly recurved 3
   Terminal leaflets narrow-lanceolate to narrow-elliptic to narrow-oblanceolate, 1–5.5 mm wide, margins usually strongly recurved to revolute though some leaves on an individual plant may be flat to slightly recurved 5

3. Abaxial surface of leaves stellate tomentose; fruit glabrous or hirsute . . **16. Z. furfuracea**
   Abaxial surface of leaves glabrous to hirsute but not stellate tomentose; fruit glabrous 4

4. Stems prominently glandular verrucose, leaf decurrencies prominent . . . **7. Z. boolbunda**
   Stems not or slightly glandular verrucose, leaf decurrencies absent or very faint . . . . . **30. Z. smithii**

5. Branches hirsute with simple, bifid and trifid hairs 6
   Branches glabrescent with scattered stellate hairs to stellate tomentose 7

6. Terminal leaflets greater than 7 mm long. . . . . **17. Z. graniticola**
   Terminal leaflets to 7 mm long . . . . . **19. Z. inexpectata**

7. Adaxial surface of leaflets with large hemispherical glands 8
   Adaxial surface of leaflets smooth or slightly glandular verrucose 9

8. Large hemispherical glands on adaxial surface of leaflets, young branches glabrous. . . . . **2. Z. adenodonta**
   Large hemispherical glands on adaxial surface of leaflets, young branches hairy. . . . . **34. Z. verrucosa**

9. Sepals glabrous or glabrescent on abaxial surface . . . . . **9. Z. collina**
Sepals stellate tomentose on abaxial surface 10

10. Branches and even the glands usually, densely tomentose . . . . . **33. Z. vagans**
Young branches glabrescent or with a sparse indumentum between the glands, glands mostly glabrous 11

11. Inflorescence 1–3-flowered; adaxial surface of leaflets glabrescent or with a sparse to moderately dense indumentum of minute stellate hairs . . **8. Z. cephalophila**
Inflorescence 3–20^{+}-flowered; adaxial surface of leaflets glabrescent with hairs along midrib and near tip only . . . . . **12. Z. distans**

12. Epidermis of abaxial surface of leaflets completely hidden by dense stellate indumentum [midrib may be visible]. 13
Epidermis of abaxial surface of leaflets clearly visible, surface glabrous, glabrescent, variously pilose, or with a sparse to moderately dense stellate indumentum. 25

13. Adaxial surface of leaflets with a moderately dense to dense stellate indumentum (hairs may be minute) 14
Adaxial surface of leaflets glabrous or sparsely to densely pilose [rarely (*Z. collina*) with the occasional minute stellate hair amongst the many simple hairs]. 15

14. Leaflets elliptic to obovate with a length/width ratio 1.8–3.3, abaxial surface shaggy with hairs to 1 mm long, with prominently raised secondary veins; petals 3.6–6 mm long . . . . . **11. Z. cytisoides**
Leaflets narrow-elliptic to oblong with a length/width ratio of 3.7–6, abaxial surface stellate tomentose with hairs less than 0.2 mm long, with obscure or slightly raised secondary veins; petals 2–2.5 mm long . . . . . **32. Z. tenuis**

15. At least some terminal leaflets > 5 cm long; abaxial surface of sepals stellate tomentose . . . . . **4. Z. arborescens**
Terminal leaflets < 4.5 cm long, if > 4.5 cm long then abaxial surface of sepals glabrous or glabrescent 16

16. Adaxial surface of leaflets hirsute, if glabrescent then leaflets obovate, 10–16 mm long; midvein on abaxial surface of leaflets hirsute; stems hirsute 17
Adaxial surface of leaflets glabrous, apart from few hairs along midrib; leaflets narrow elliptic to elliptic to slightly obovate, 10–43 mm long, midvein on abaxial surface glabrous or hirsute; stems glabrous or hirsute 20

17. Terminal leaflets obovate; petioles sparsely pilose, some bifid and stellate hairs present also; peduncles and pedicels glabrous . . . . . **14. Z. exsul**
Terminal leaflet elliptic to lanceolate; petioles stellate tomentose; peduncles and pedicels with a sparse to dense indumentum. 18

18. Adaxial surface of leaves with simple and stellate hairs, rays *c.* 0.1 mm long; abaxial surface of sepals glabrous . . . . . **9. Z. collina**
Adaxial surface of leaves with simple hairs, hairs 0.25–1 mm long; abaxial surface of sepals with a sparse to moderately dense indumentum. 19

19. Terminal leaflets elliptic, 3.5–10 mm wide, margins flat to recurved; petiole 3–8 mm long . . . . . **10. Z. compacta** (Bull Creek Gorge)
Terminal leaflets narrow elliptic, 1–3 mm wide, margins recurved to revolute; petiole 0.5–1 mm long . . . . . **35. Z. whitei**

20. Stems with an indumentum that is usually evenly distributed around stem though sometimes denser between decurrent leaf bases 21
Stems glabrous or hirsute between decurrent leaf bases only, other areas glabrous or glabrescent 23

21. Stems glandular verrucose . . . . . **33. Z. vagans**
Stems not glandular verrucose 22

22. Leaflets elliptic to obovate, margin recurved [sometimes revolute on drying], tip subacute to rounded, minutely mucronate; the midrib of the abaxial surface has a stellate indumentum as or nearly as dense as that of lamina; pedicel with a moderately dense indumentum; sepal tip acute, inflexed [can be difficult to see]; cocci hirsute, if only on adaxial margin. . . . . **10. Z. compacta**
Leaflets narrow-elliptic to narrow-obovate, margin revolute, tip subulate to acute; the midrib of the abaxial surface glabrous or with indumentum markedly less dense than lamina; pedicel glabrous or with a sparse indumentum; sepal tip slightly acuminate, not inflexed; cocci glabrous . . . . . **15. Z. fraseri**

23. Staminal filaments hirsute; sepals > 2 mm long . . . . . **21. Z. laevigata**
Staminal filaments usually glabrous, rarely hirsute; sepals < 2 mm long 24

24. Branches without decurrent leaf bases, circular in cross section; leaflets usually with abaxial surface exposed, 1–6 mm wide . . . . . **15. Z. fraseri** (Blackdown Tableland)
Branches with decurrent leaf bases, ± square in cross section; leaflets usually so revolute that abaxial surface hidden, 1–3.5 mm wide . . . . . **22. Z. laxiflora**

25. Inflorescence as long or longer than the subtending leaf. 26
Inflorescence shorter than the subtending leaf 37

26. Petioles to 1.5 mm long 27
Longer petioles 2–16 mm long 31

27. Leaflets obovate, margins flat to recurved, terminal leaflets (2–) 3–7 mm wide 28
Leaflets narrow elliptic to narrow obovate (rarely elliptic and then < 2.5 mm wide), margins usually recurved to revolute, terminal leaflets 0.5–3 mm wide [occasional simple leaf to 4 mm wide]. 29

28. Adaxial surface of leaflets densely pilose; at anthesis inflorescence shorter than leaves though sometimes longer when in fruit; fruit glabrous or hirsute. . . . . **24. Z. minutiflora**
Adaxial surface of leaflets glabrescent to sparsely pilose; inflorescence at anthesis longer than leaves; fruit glabrous or glabrescent . . . . . **26. Z. obovata**

29. Abaxial surface of leaflets glabrous or with an indumentum of simple and bifid hairs . . . . . **5. Z. aspalathoides**
Abaxial surface of leaflets with a stellate indumentum 30

30. Leaflets with revolute margins and virtually no abaxial surface visible; abaxial surface of sepals with a sparse indumentum. . . . . **5. Z. aspalathoides** (Moura)
Leaflets with recurved to revolute margins, many with clearly visible abaxial surface; abaxial surface of sepals with a moderately dense to dense indumentum . . . . . **35. Z. whitei**

31. Abaxial surface of leaflets with a stellate indumentum; petioles to 16 mm long . . . 32
Abaxial surface of leaflets with an indumentum of simple and/or bifid hairs, though a few stellate hairs may also be present; petioles to 7 mm long . . . 34

32. Young branches with decurrent leaf bases . . . **28. Z. robertsiorum**
Young branches without decurrent leaf bases . . . 33

33. Leaflets obovate . . . **26. Z. obovata**
Leaflets narrow elliptic to elliptic . . . **30. Z. smithii**

34. Young branches pilose, with hairs evenly distributed around stems; leaflets elliptic to obovate . . . **6. Z. bifida**
Young branches puberulous or pilose, with hairs much denser in or confined to area between decurrent leaf bases; leaflets narrow elliptic to elliptic to lanceolate . . . 35

35. Branches slightly glandular verrucose . . . **17. Z. graniticola**
Branches smooth, not glandular verrucose . . . 36

36. Abaxial surface of sepals with hairs scattered over entire surface . . . **20. Z. insularis**
Abaxial surface of sepals glabrous with hairs only at base . . . **27. Z. rimulosa**

37. Stems pilose, sometimes also with bifid and small stellate hairs . . . 38
Stems glabrous, or stellate glabrescent to stellate tomentose . . . 40

38. Abaxial surface of petals with scattered simple and bifid hairs . . . **6. Z. bifida**
Abaxial surface of petals with a dense stellate indumentum . . . 39

39. Petioles to 1 mm long . . . **5. Z. aspalathoides**
Some petioles > 2 mm long . . . **17. Z. graniticola**

40. At least some of the terminal leaflets > 45 mm long . . . 41
Terminal leaflets < 45 mm long . . . 44

41. Abaxial surface of sepals glabrescent with few stellate hairs concentrated at base and/or on margins . . . **30. Z. smithii**
Abaxial surface of sepals stellate tomentose, at least between raised glands . . . 42

42. Abaxial surface of leaflets hirsute to velutinous . . . **4. Z. arborescens**
Abaxial surface of leaflets glabrous or glabrescent . . . 43

43. Peduncles glabrous or glabrescent; sepals > 1 mm long . . . **4. Z. arborescens**
Peduncles hirsute; sepals < 0.9 mm long . . . **31. Z. southwellii**

44. Young branches without decurrent leaf bases . . . 45
Young branches with decurrent leaf bases . . . 48

45. Petals 4–5.5 mm long . . . **31. Z. southwellii**
Petals 2–3 mm long . . . 46

46. Adaxial surface of leaflets glabrescent or with scattered stellate and bifid hairs . . . **30. Z. smithii**
Adaxial surface of leaflets sparsely to densely pilose . . . 47

47. Leaflets narrow elliptic to narrow lanceolate, adaxial surface of leaflets sparsely pilose . . . **18. Z. hydroscopica**
Leaflets obovate, adaxial surface of leaflets densely pilose . . . **24. Z. minutiflora**

48. Young branches with a sparse to dense indumentum, sometimes only between decurrent leaf bases 49
Young branches glabrous or glabrescent 51

49. Abaxial surface of leaflets with a sparse to moderately dense stellate indumentum, sometimes only on midrib (close inspection may be required) . . . . . **28. Z. robertsiorum**
Abaxial surface of leaflets glabrous or glabrescent. 50

50. Branches with indumentum between decurrent leaf bases only, otherwise glabrous or glabrescent . . . . . **7. Z. boolbunda**
Branches with a moderately dense indumentum evenly spread around branches. . . . . **13. Z. eungellaensis** (Mt David)

51. Young branches without prominently raised decurrent leaf bases; abaxial surface of sepals glabrous 52
Young branches with prominently raised decurrent leaf bases; abaxial surface of sepals with a stellate indumentum, at least at base 53

52. Young stems not glandular verrucose. . . . . **1. Z. actites**
Young stems glandular verrucose (sometimes sparingly so) . . . . . **29. Z. scopulus**

53. Inflorescence 10–20(–50)-flowered, most flowers opening at the same time . . . . . **25. Z. montana**
Inflorescence 1–10-flowered, 1–3 flowers opening at any one time 54

54. Largest leaflets < 15 mm long. . . . . **13. Z. eungellaensis** (Mt William, Mt Dalrymple)
Largest leaflets > 15 mm long. 55

55. Tip of leaflets acute . . . . . **3. Z. alata**
Tip of leaflets obtuse . . . . . **23. Z. madida**

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1. Zieria actites Duretto & P.I.Forst., **species nova** *Z. compactae* C.T.White affinis a qua folioli laminis infra glabris (adversum dense stellato-tomentosa), costa supra non impressa (adversum valde impressa), marginibus folioli non recurvatis (in illa planis usque recurvatis) et petalo minore (1.8–2 × 0.9–1 mm adversum 3.5–5 × 1.2–3.3) differt. **Typus:** Queensland. Port Curtis District: Mt Larcom, 5 km NW of Yarwun, 25 January 1994, *P.I.Forster PIF14654* (holo: BRI; iso: MEL 306831).

Zieria sp. (Mt Larcom N.Gibson TOI8); Forster (1997b: 188; 2002: 181; 2007: 183).

Shrub to 1 m tall, forming a densely compact bush, glabrous or glabrescent with simple, bifid or stellate hairs on all parts apart from flowers. Stems erect, wiry; branches with slightly decurrent leaf bases, very weakly glandular verrucose. Leaves palmately trifoliolate, with an aniseed smell; petioles 2–10 mm long; terminal leaflets lanceolate to elliptic, (13–) 20–28 × 6.5–11 mm, laminae pellucid gland-dotted, not glandular verrucose, tips acute, margins crenulate and slightly recurved, midribs raised slightly abaxially and weakly glandular verrucose, secondary veins obscure; lateral leaflets similar to terminal leaflets but smaller, (10–) 15–22 × (4.5–) 7–9 mm. Inflorescence axillary, shorter than the subtending leaf, 9–20-flowered, not obviously glandular; peduncle 8–20 mm long; bracts linear-lanceolate, persistent, 1–3.5 mm long; secondary peduncles 3–6 mm long; pedicels 1.5–4 mm long, not obviously glandular, glabrous. Sepals deltate, 1–1.5 × *c.* 1 mm, imbricate in bud, not obviously glandular, tips acute, glabrous. Petals narrow-elliptic, 1.8–2 × 0.9–1 mm, cream to pale pink, imbricate in bud, not obviously glandular, with scattered stellate and simple hairs along margins of adaxial and abaxial surfaces. Staminal filaments 0.7–0.8 mm long, glabrous, eglandular; anthers *c.* 0.5 mm long, apiculum

absent. Gynoecium glabrous. Cocci 3–3.5 × 1.8–2 mm, not glandular verrucose, glabrous, base of style persistent forming a minute apical apiculum. Seeds oblong-ovoid, 2.2–2.5 × 1.2–1.3 mm, black-purple, dull, slightly longitudinally striate. **Fig. 1.**

***Additional specimens examined*: Queensland.** PORT CURTIS DISTRICT: Top of Mt Larcom, Mar 1966, *Blake 22446* (BRI, CANB); 6 km NW of Yarwun, Mt Larcom, Mt Larcom Range, May 1988, *Gibson TO18* (BRI); Mt Larcom Peak, 7 km NW of Yarwun, Sep 1993, *Brushe 1358 & Williams* (BRI); Mt Larcom south peak, 17.5 km WNW of Gladstone, Apr 1995, *Brushe JB260 et al.* (BRI).

***Notes*:** *Zieria actites* appears to have some affinity to *Z. compacta*; however, *Z. actites* differs from that species in the leaf laminae being glabrous below (versus densely stellate tomentose), the midrib not impressed above (versus strongly impressed), the leaflet margins being thickened, but not recurved (versus flat to recurved) and the smaller petals (1.8–2 × 0.9–1 mm, versus 3.5–5 × 1.2–3.3 mm). Further affinities may be perhaps sought with *Z. montana* from which it can be distinguished in having slightly decurrent leaf bases on younger branches only (versus

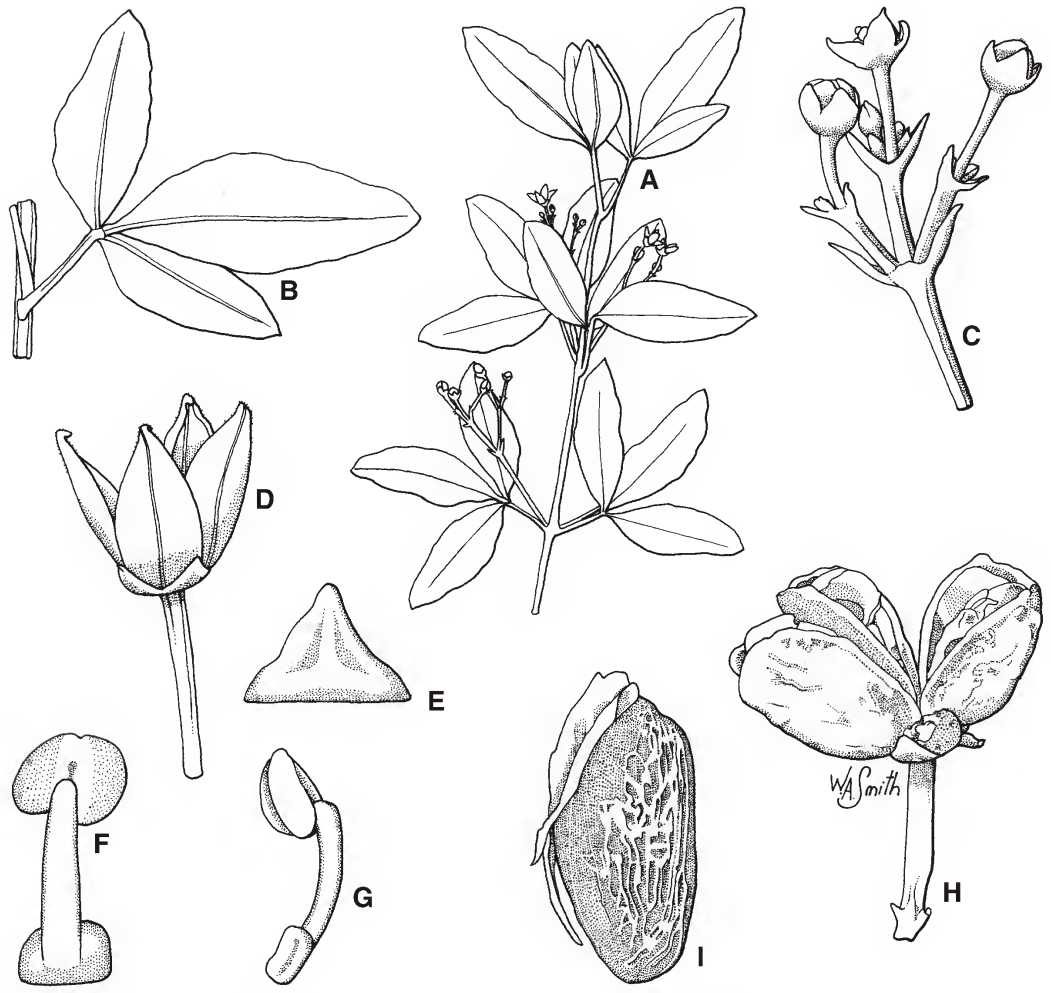

Fig. 1. ***Zieria actites*.** A. branch with several flowering inflorescences × 1. B. stem node with abaxial view of leaf × 2. C. inflorescence with flower and buds × 6. D. flower × 8. E. tip of sepal × 20. F–G. views of stamens × 20. H. mature fruit with multiple cocci × 8. I. lateral view of seed × 16. A–C from *Forster PIF14654* (BRI); D–I from *Gibson TO18* (BRI). Del. W. Smith.

prominently decurrent leaf bases) and crenulate leaf margins (versus margins entire or crenulate towards tip).

***Distribution and habitat*:** *Zieria actites* is endemic to Qld and is known only from the type locality of Mt Larcom (**Map 11**), an isolated peak composed of quartz alunite alteration of the Targinnie Quartz Monzonite (Willmott 2006), west northwest of Gladstone within the Brigalow Belt bioregion. At Mt Larcom the species is found in open woodland/ shrubland in crevices and clefts on exposed outcrops and clifflines at *c.* 630 m.

***Phenology*:** Flowers, fruit and seed have been collected from September to May.

***Conservation status*:** Mt Larcom is not in a conservation reserve and with the walking track to the summit, is a popular destination for bushwalkers. The population of *Zieria* is not large (less than 1000 individuals) and the species can be assessed as **Endangered** under the criteria of B2a,b(i,ii,iii,v), C2a(ii) (IUCN 2001). Current threats are habitat destruction or amelioration by fire, weeds and general disturbance. It co-occurs with the Vulnerable listed *Parsonsia larcomensis* J.B.Williams.

***Etymology*:** The specific epithet is derived from the Greek *actites* (a watcher) and alludes to the populations of this plant occurring on the top of a mountain where the Pacific Ocean can be viewed.

2. Zieria adenodonta (F.Muell.) J.A.Armstr., *Austral. Syst. Bot.* 15: 299 (2002); *Zieria granulata* (F.Muell.) C.Moore ex Benth. var. *adenodonta* F.Muell., *Fragm.* 9: 116 (1875). **Type:** New South Wales. North Coast: Highest mountains on the Tweed, *Carron s.n.* (lecto [designated by Armstrong (2002: 299)]: MEL 62069; isolecto: MEL 62068, NSW 2565).

***Illustrations*:** Armstrong (2002: 300, 301); Logan River Branch SGAP (QLD Region) Inc. (2005: 363).

***Additional selected specimens examined*: Queensland.** Moreton District: Lower Bellbird Circuit track, Binna Burra section, Lamington N.P., 28°12′S, 153°11′E, Jul 1994, *Grimshaw G854* (BRI); Shipstern Range, northern ridge of MacPherson Range [Lamington N.P.], 28°12′S, 153°12′E, May 1969, *Telford 647* (CANB); Lamington N.P., Lower Ballanjui Track, near Yangahla Lookout, 28°12′S, 153°12′E, Sep 1978, *McDonald 2438* (BRI, CANB); Lamington N.P., on track to Ballanjui Falls, just below Yangahla Lookout, 28°13′S, 153°12′E, Dec 1986, *Beesley 999A & Ollerenshaw* (BRI, CANB; NSW *n.v.*).

***Distribution and habitat*:** This species has a limited distribution with populations on Mt Warning in NSW and in Lamington N.P. in Qld (**Map 12**) within the Southeast Queensland bioregion at or around Yangahla Lookout, Nixons Creek and Mt Roberts. Plants grow in open areas on rock-pavement (rhyolite) often in shrubland dominated by *Leptospermum petersonii* and *Lophostemon confertus* or in tall open forest of *Eucalyptus campanulata*, *E. microcorys* and *L. confertus* on basalt. It may possibly be stimulated by disturbance, as is *Z. collina* (Fitzsimmons 1999), such as would occur from occasional storm damage or fire.

***Phenology*:** Flowers have been collected from May to September, and fruit from November to January.

***Conservation status*:** This species is currently listed as **Rare** in Qld (*NCR* 2006). It has been infrequently collected with most collections in Qld from near or around Yangahla Lookout. This is perhaps more a reflection of its occurrence in long-standing National Parks than true rarity, but the exclusion of fire from some of its N.P. habitat may mean that little recruitment occurs. Grimshaw in his *G854* specimen label notes recorded it as uncommon.

3. Zieria alata Duretto & P.I.Forst., **species nova** a *Z. montana* J.A.Armstr. floribus paucioribus in quaque inflorescentia (3–12 adversum 10–20+), decurrentiis folii manifeste (adversum leviter vel non) glandulari-verrucosis et foliis acutis (non obtusis) differt. **Typus:** Queensland. Cook District: North Mary Logging Area, State Forest 143, 16°31′S, 145°16′E, 17 July 1994, *P.I.Forster PIF15630*, *G.Sankowsky & M.C.Tucker* (holo: BRI; iso: MEL, NSW).

Shrub to 3 m tall forming an open, somewhat straggly bush. Stems erect to decumbent, wiry; branches with prominent, narrow and raised decurrent leaf bases, prominently glandular verrucose especially along decurrent leaf

bases, glabrous to glabrescent; older branches not lenticellate and corky, conspicuously scarred from the fallen buds and leaves. Leaves palmately trifoliolate; petioles (8–) 12–18 mm long, very slightly glandular verrucose, glabrous or glabrescent; terminal leaflets elliptic to obovate, 22–41 × 7–13 mm, laminae not glandular verrucose, glabrous, tips acute, margins entire or crenulate towards tip, flat, midveins raised abaxially, secondary veins obscure; lateral leaflets similar to terminal leaflets and usually *c.* the same length. Inflorescence axillary, shorter than the subtending leaf, 3–7 (–12)-flowered, only 1–3 flowers opening at a time; peduncle 8–16 mm long, with prominent ridges, glandular verrucose, glabrous or glabrescent; bracts scale like, persistent, slightly glandular verrucose, stellate glabrescent; pedicels 2–2.5 mm long, prominently ridged, sparsely stellate tomentose. Sepals broadly deltate, *c.* 0.7 mm long and wide, slightly imbricate in bud, not or slightly glandular verrucose, tips acute, adaxial surfaces glabrous, abaxial surfaces sparsely stellate pubescent at the base. Petals elliptic, 3.5–4 × 1.7–2 mm, white to cream to pale pink, dotted with pellucid glands abaxially, stellate pubescent on both surfaces. Staminal filaments 1.5–1.7 mm long, glabrous or with few small hairs, particularly towards the apex, slightly glandular distally; anthers 0.5–0.6 mm long, apiculum absent. Gynoecium glabrous. Cocci *c.* 3 × 1.7 mm, smooth, glabrous, base of style persistent forming a minute apical apiculum. Mature seeds not observed. **Fig. 2.**

***Additional selected specimens examined*: Queensland.** Cook District: Devil's Thumb [Daintree N.P.], 16°23′S, 145°17′E, Sep 1997, *Jago 4501* (BRI); Mt Lewis, 27 km from the Rex highway on the main forestry road, 16°30′S, 145°16′E, Sep 1986, *Clarkson 6565* (BRI, MEL); S.F.R. 143, North Mary L.A., 16°13′S, 145°15′E, Jul 1977, *Gray 614* (BRI, NSW); S.F.R. 143, North Mary L.A., 16°32′S, 145°16′E, Nov 1995, *Gray 6405* (QRS); *c.* 1 km west of Mt Lewis road, 16°31′S, 145°16′E, Sep 1996, *Jago 4103* (BRI, DNA); Mt Lewis, 16°31′S, 145°16′E, Apr 1998, *Wannan 754 & Jago* (NSW); S.F. 143, North Mary L.A., 27 km along Mt Lewis road, 16°31′S, 145°16′E, Mar 2001, *Forster PIF26979 et al.* (BRI, HO, MEL); Ridge top above Mt Lewis road, 16°31′S, 145°17′E, Aug 1986, *Weston 756 et al.* (NSW); Mt Lewis, 16°35′S, 145°17′E, Aug 1996, *Telford 12215* & *Donaldson* (BRI, CANB, NE, NSW).

***Notes*:** Collections of *Zieria alata* were formerly included within the broad concept for *Z. montana* (Armstrong 1991a; 2002). There is a considerable latitudinal geographic disjunction between the type locality of *Z. montana* and the populations on Mt Lewis and the Devil's Thumb. *Z. alata* differs from *Z. montana* by having fewer flowers per inflorescence (3–12, verses 10–20+), markedly glandular verrucose leaf decurrencies (versus slightly or not so) and acute leaves (versus obtuse).

Zieria alata appears to be closely allied to *Z. madida* Duretto & P.I.Forst., but differs from that species in the leaf bases being prominently glandular verrucose (versus not or slightly glandular verrucose), leaflets with acute tips (versus obtuse) and the peduncles being glandular verrucose (versus not). The similar general morphology and occurrence of these two taxa in similar habitats within the Wet Tropics bioregion may indicate that they are closely related taxa.

***Distribution and habitat*:** *Zieria alata* is endemic to Qld where it is narrowly distributed in the Wet Tropics bioregion (**Map 12**). It is apparently confined to areas over 1000 m in the Main Coast Range to the west of the Daintree River and Mossman that includes Mt Lewis and the Devil's Thumb. The species is found in windswept heath (with *Acrothamnus spathaceus, Leptospermum wooroonooran* and *Paphia meiniana*) and stunted closed forest (e.g. complex notophyll vine forest and evergreen microphyll moss-fern thicket) in clefts and crevices or areas of monocotyledon-dominated mats amongst boulders or on pavements of granite.

***Phenology*:** Flowers have been collected in March and from July to September, and fruit in March, July and September.

***Conservation status*:** This species can be locally frequent (*Telford 12215*) or occasional (*Forster PIF26979*) where found; however, the available habitat of granite domes and pavements is small. Nearly all of the cited collections have been made within 1 km of the Mt Lewis forestry road and the species should be searched for in similar habitats near Black Mountain and Mt Spurgeon in the

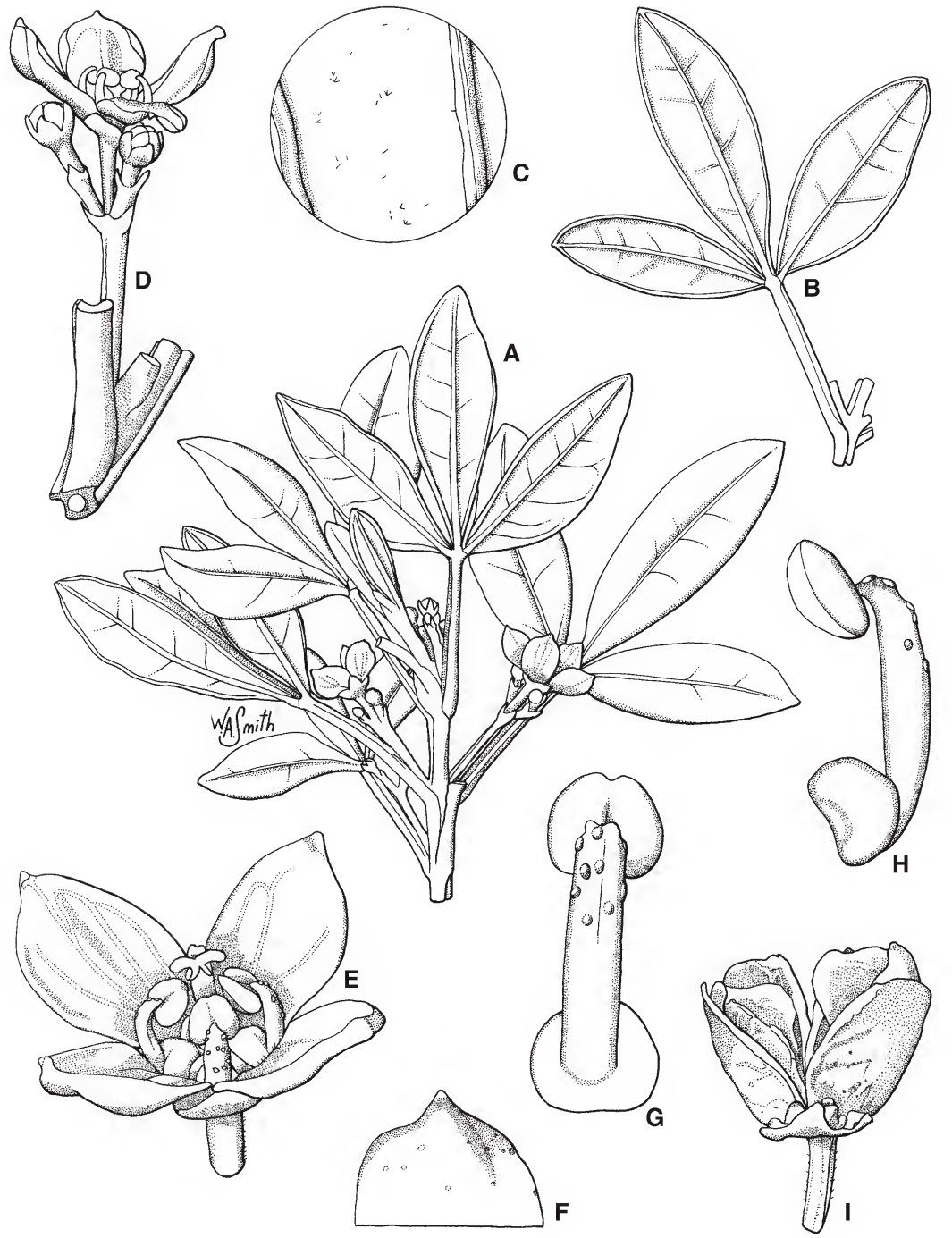

Fig. 2. *Zieria alata*. A. branch with several flowering inflorescences × 2. B. stem node with abaxial view of leaf × 2. C. detail of indumentum on abaxial surface of leaflet × 8. D. inflorescence with flower and buds × 4. E. flower × 8. F. tip of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. A–C from *Forster PIF26979* (BRI); D–I from *Forster PIF15630* (BRI). Del. W. Smith.

same range. No detailed assessment has been made of the number of populations, number of individuals, the area of occupancy or perceived threats for this species; however it can be assessed as **Vulnerable** under the D2 criterion (IUCN 2001) purely on the restricted distribution.

***Etymology*:** The specific epithet is derived from the Latin *alatus* (winged) and alludes to the prominently decurrent leaf bases on young branches, which are the most prominent for this group of species.

4. Zieria arborescens Sims, *Bot. Mag.* 34: t. 1395 (1811). **Type:** Tasmania. MIDLANDS: Port Dalrymple, 1802–5, *R.Brown 5279* (lecto [designated by Armstrong (2002: 307)]: BM 630980 [images BRI, HO 534650]; isolecto: BM 630979 [images BRI, HO 534649], K 347902 [images BRI, HO 534660], MEL [61987, 61992]).

***Notes*:** Armstrong (2002) recognised three subspecies in *Zieria arborescens* with *Z. arborescens* subsp. *arborescens* and *Z. arborescens* subsp. *glabrifolia* in Qld. The characters used to distinguish these last two subspecies are mutually exclusive in Qld though when material from other states is used then Armstrong's key to the subspecies does not work.

Key to the subspecies of *Z. arborescens* found in Queensland

1. Abaxial surface of leaflets with dense indumentum . . . . . subsp. **arborescens**
   Abaxial surface of leaflets glabrous or glabrescent. . . . . subsp. **glabrifolia**

4a. Zieria arborescens Sims subsp. **arborescens**

***Illustrations*:** Armstrong (2002: 308, 309); Logan River Branch SGAP (QLD Region) Inc. (2005: 363) [as *Z. arborescens*].

***Additional selected specimens examined*: Queensland.** MORETON DISTRICT: 1.2 km along Carrick road, Springbrook, 28°11′S, 153°16′E, Oct 1997, *Bean 12487* (BRI, MEL, NSW); Start of Dave's Creek track, Binna Burra, Lamington N.P., 28°12′S, 153°11′E, Oct 1998, *Leiper s.n.* (BRI [AQ664305]); Dave's Creek circuit walking track, Dave's Creek, Binna Burra Section, Lamington N.P., 28°13′S, 153°12′E, Jul 1994, *Grimshaw G882 & Flenady* (BRI); Springbrook, 28°14′S, 153°16′E, Sep 1990, *Leiper s.n.* (BRI [AQ473933]); Springbrook, 28°14′S, 153°17′E, Dec 1993, *Bean 7175* (AD, BRI, CANB, NSW).

***Distribution and habitat*:** *Zieria arborescens* subsp. *arborescens* is widespread in south-eastern Australia, with populations in Tasmania, and on mainland Australia from Victoria up to the extreme south-eastern corner of Qld at the Springbrook and Lamington plateaux within the Southeast Queensland bioregion (**Map 5**). There is also an isolated population at Mt Norman in Girraween N.P. near Stanthorpe within the New England Tableland bioregion. On the Springbrook and Lamington plateaux plants occur in 'wet' open eucalypt forest dominated by canopy species such as *Eucalyptus campanulata* and *Allocasuarina torulosa*, often with mixed rainforest taxa in the understorey, on substrates derived from basalt or rhyolite. At Mt Norman *Z. arborescens* subsp. *arborescens* grows amongst massive granite boulders.

***Phenology*:** Flowers have been collected from August to October, and fruit from October to December.

***Conservation status*:** This subspecies is common and widespread with the Qld populations mainly found in National Parks such as Girraween, Lamington and Springbrook. The population at Mt Norman, Girraween N.P., is small and quite disjunct from other populations. This population is geographically very close to, but at a much higher altitude, than populations of *Z. arborescens* subsp. *glabrifolia*. The conservation status is assessed as **Least Concern** (IUCN 2001).

4b. Zieria arborescens subsp. **glabrifolia** J.A.Armstr., *Austral. Syst. Bot.* 15: 312 (2002). **Type:** Queensland. DARLING DOWNS DISTRICT: Baboon Gully, Girraween National Park, *c.* 2 km N of Ranger Station, 28°50′S, 151°55′E,

28 September 1977, *J.A.Armstrong 1153* (holo: NSW 458810; iso [as per Armstrong (2002)]: BRI, CANB *n.v.*, MEL 2281421, PERTH *n.v.*).

***Additional specimens examined*: New South Wales.** NORTHERN TABLELANDS: Bismuth Falls, WSW of Torrington, 29°17′S, 151°45′E, Oct 1990, *Williams & White NRAC4* (BRI, CANB *n.v.*, NE, NSW *n.v.*); Bismuth Falls, Torrington, 29°17′S, 151°45′E, Oct 1991, *Williams & White s.n.* (NE 58268).

***Notes*:** This subspecies was distinguished from *Z. arborescens* subsp. *arborescens* by Armstrong (2002) on the leaves being glabrous below (versus hirsute to densely stellate-tomentose), the petiole being glabrous abaxially (versus stellate-tomentose) and the peduncle being glabrous or with scattered stellate hairs (versus tomentose with stellate hairs). This distinction does not always work with material outside Qld (see *Notes* under *Z. arborescens*).

***Distribution and habitat*:** Armstrong (2002) considered *Zieria arborescens* subsp. *glabrifolia* to be endemic to Qld.

In Qld, *Zieria arborescens* subsp. *glabrifolia* is narrowly distributed in the New England Tableland bioregion (**Map 6**). It has been found in Girraween N.P., at Baboon Gully [type locality] and Bald Rock Creek, and near Stanthorpe at Donnelley's Castle and Jolly's Falls. In NSW, it has been collected from Bismuth Falls near Torrington, Northern Tablelands, NSW. At Baboon Gully and Bismuth Falls plants were collected in dry sclerophyll forest on granite.

***Phenology*:** Flowers have been collected in September and October, and fruit in October.

***Conservation status*:** The most recent collection of this subspecies in Qld was made in 1983 from Donnelley's Castle. Collections from the other cited Qld localities were all made in the early 1970s. Survey work to determine the number of extant populations, number of individuals, area of occupancy and perceived threats is urgently required to enable an accurate conservation status to be determined. An **Endangered** conservation status is appropriate on the criteria of B2a,b(i-v) (IUCN 2001). Paucity of collections, apparent restricted and often disjunct distributional patterns appear to be common features for taxa of Rutaceae that are restricted to the 'Granite Belt' of Qld (see also *Z. graniticola* below, and Duretto (1999a, 1999b, 2003) and Duretto *et al.* (2005) for discussions on species of *Boronia*).

***Notes*:** The recent two collections (see *Distribution and habitat*) from Bismuth Falls (NSW) are a good match for *Z. arborescens* subsp. *glabrifolia* though they do appear to have larger leaflets, peduncles, bracts and pedicels. Further field research is required to determine if this variation warrents taxonomic recognition.

5. Zieria aspalathoides A.Cunn. ex Benth., *Fl. Austral.* 1: 305 (1863). **Type:** Queensland. DARLING DOWNS DISTRICT [probably]: The Grampians, gathered on a range of Granite Mountains in lat. 28°40′S, long. *c.* 152°, June 1827, *A.Cunningham 39* (lecto [designated by Armstrong (2002: 313)]: K 347907 [Alan Cunningham's Australian Herbarium; images BRI, HO 534659]; isolecto: BM 829821 [images BRI, HO 534652], BRI [AQ318520] [specimen on right hand side of sheet]).

***Notes*:** Armstrong (2002) chose to recognise some populations on the Blackdown Tableland as *Z. aspalathoides* subsp. *brachyphylla*. He used three character states to distinguish between the two subspecies of *Z. aspalathoides*: *viz.*, paraphrasing Armstrong, leaflet lamina generally 5–8 mm long (subsp. *aspalathoides*) or less than 2.5 mm long (subsp. *brachyphylla*), younger branches commonly with a line of simple hairs arranged in an alleotrichous configuration (subsp. *aspalathoides*) or younger branches entirely hirsute (subsp. *brachyphylla*), and inflorescences mostly 3-flowered (range 1–13) (subsp. *aspalathoides*) or inflorescences mostly 1-flowered (range 1–3) (subsp. *brachyphylla*). Of these three characters only the first is useful in distinguishing these taxa. Many specimens of *Z. aspalathoides* subsp. *aspalathoides* have 1-flowered inflorescences and hairs distributed over the entire stem. The type material of *Z. aspalathoides* subsp. *brachyphylla* has stems with the density of hairs between the decurrent leaf bases much greater than that of the other areas (as with the typical subspecies). Even leaf

length is problematic as some specimens of *Z. aspalathoides* subsp. *aspalathoides* from the Springsure area (e.g. *Ballingal 2603*, *Cockburn s.n.* [AQ195493], *Gittins T67*) have very small leaflets (2–5 mm long).

These two subspecies are recognised here and *Zieria aspalathoides* subsp. *brachyphylla* is considered to be restricted to the Blackdown Tableland. *Z. aspalathoides* subsp *aspalathoides* is also found on the Blackdown Tableland. Detailed population studies are required on the Blackdown Tableland and in the Springsure area to determine if this classification is warranted or whether it is merely extreme variation. This pattern of variation has also been observed in *Boronia obovata* C.T.White, which is also present in the Blackdown Tableland area and displays a wide range in leaflet size (range 6–42 mm long) with some plants having only very small leaflets while others have relatively large leaflets. Use of herbarium collections alone suggested that there were maybe two taxa. Fieldwork has shown that, in the case of *B. obovata*, leaflet size is not consistent in a population, and is dependent on the amount of exposure and/or on the age of the plant (MFD, pers. obs 1992; PIF, pers. obs. 2005), and so, not a reliable character for taxonomic use (Duretto 1999a). This has also proved to be the case in some other species of *Boronia* (*cf.* Duretto 1999a, 1999b, 2003).

Several new taxa allied to *Zieria aspalathoides* are described in this paper (see accounts of *Z. graniticola*, Z. *inexpectata* and *Z. whitei*). See also the discussion under *Z. aspalathoides* subsp. *aspalathoides.*

Key to the subspecies of *Z. aspalathoides*

1. At least some leaflets > 4 mm long . . . . . subsp. **aspalathoides**
   Leaflets < 3 mm long . . . . . subsp. **brachyphylla**

5a. Zieria aspalathoides A.Cunn. ex Benth. subsp. **aspalathoides**

Zieria aspalathoides var. (Springsure L.Cockburn AQ195493); Forster (2002: 181).

***Illustrations*:** Williams (1987: 319) [as *Z. aspalathoides*]; Pearson & Pearson (1989: 403) [as *Z. aspalathoides*]; Armstrong (2002: 315, 316).

***Additional selected specimens examined*: Queensland.** Cook District: Wollem Trig – Atherton, 17°16′S, 145°27′E, Sep 1980, *Hind 2680* (NSW). North Kennedy District: Herberton, Jan 1912, *Kenny s.n.* (BRI [AQ195487]); Marble Creek mesa, SE of Greenvale, 19°07′S, 145°14′E, Apr 1991, *Bean 2918* (BRI); Mingela Bluff, 'Maidavale', E of Mingela, 19°53′S, 146°43′E, Apr 1991, *Bean 2975* (BRI); 6 km NNW of 'Liontown', Just Range area, 20°21′S, 146°01′E, Nov 1991, *Thompson 404 & Robins* (BRI); 9.2 km SSE from 'Redcliffe Vale', 21°11′S, 148°09′E, Nov 2000, *Perry & Lawler s.n.* (BRI [AQ498312]). Warrego District: 8 km E Chesterton N.P. house, Chesterton N.P., 40 km NE of Morven, 26°08′S, 147°16′E, Nov 1995, *Dollery s.n.* (BRI [AQ489935]). Leichhardt District: Ropers Peak, Peak Range, 22°52′S, 148°13′E, Aug 1990, *Forster PIF7213* (BISH, BRI, CANB, MEL); Two Mile Creek, Blackdown Tableland [N.P.], SE of Blackwater, 23°45′S, 149°06′E, Jan 1996, *Bean 9625* (BRI); Oakey Creek, 24°12′S, 148°10′E, Jul 1986, *O'Keefe 842* (BRI); *c.* 80 km SW of Springsure to Tambo road, 24°22′S, 147°15′E, Sep 1990, *Ballingall 2603* (BRI); Palmgrove N.P., Bigge Range, NW of Taroom, 24°53′S, 149°27′E, Sep 1999, *Forster PIF24748 & Booth* (BRI, MEL); Palmgrove N.P., NW of Taroom, 25°01′S, 149°16′E, Nov 1998, *Forster PIF23644 & Booth* (AD, BRI, MEL); Isla Gorge N.P., hill W of Leichhardt Highway, 55 km NNE of Taroom, 25°10′S, 150°00′E, Aug 1997, *Halford Q3346B & Holland* (BRI); Precipice N.P., catchment of Cables Creek, 25°23′S, 150°07′E, Sep 1996, *Forster PIF19776* (BRI); 2 miles [3.3 km] N of 'Mt Playfair', 90 miles SW of Springsure, Aug 1966, *Gittins T67* (BRI); East of 'Mantuan Downs' Station towards Springsure, Aug 1962, *Cockburn s.n.* (BRI [AQ195493]); W of Moura, Apr 1961, *Jones 1809* (BRI); 14 km N of Gurulmundi on Woleebee road, Sep 1973, *Trapnell 309 & Williams* (BRI). Burnett District: 3 km W of Cynthia, S of Monto, 25°12′S, 151°06′E, Sep 1999, *Bean 15296 & McDonald* (BRI). Darling Downs District: Percy Grant road, Barakula S.F., N of Chinchilla, 26°22′S, 150°44′E, Apr 1989, *Bean 1033* (BRI); Dalby – Durong road, 2.4 km S of Darr Creek crossroads, 26°34′S, 151°07′E, Nov 1997, *Bean 12550* (BRI); Near fire tower site, Nudley S.F. 93, *c.* 20 km NNW of Jandowae, 26°35′S, 151°01′E, Dec 1997, *Bean 12644* (BRI); Peters road, N of Cooby Dam, N of Toowoomba, 27°21'S, 151°56'E, May 1997, *Bean 11985* (BRI); Bony Mt, 14 km SW of Allora, 28°06′S, 151°52′E, Aug 1999, *Bean 15256* (BRI, MEL, NSW); Headwaters of Pariagara Creek, 7 km W of Bringalily Forestry Lookout Fire Tower, 28°11′S, 151°02′E, Sep 1992, *Forster PIF11660* (BRI, MEL, NSW); Red Rock Gorge, Sundown N.P., Aug 1983, *Haselgrove SD55* (BRI); Mt Jibbinbar, Sundown N.P., 34 km WSW of Stanthorpe, 28°47′S, 151°37′E, Sep 1996, *Halford Q2962* (BRI).

***Notes*:** As noted by Armstrong (2002), *Zieria aspalathoides* subsp. *aspalathoides* is widespread (ranging from north Qld to central Victoria) and extremely variable. As with *Z. smithii*, *Z. aspalathoides* is a widespread species with numerous closely related and often locally endemic taxa distributed near and within its range. Further study may well find justification for recognition of more taxa.

Examples of unusual morphological variation can be found in the following collections.

(1) A specimen collected from west of Moura (*Jones 1809*) has stellate indumentum on the branches and the abaxial surface of the leaves. *Z. aspalathoides* normally has an indumentum of simple hairs.

(2) Some small-leaved specimens collected in central Qld (e.g. *Cockburn s.n.* AQ195493) have leaves only slightly larger than *Z. aspalathoides* subsp. *brachyphylla* (see discussion under *Z. aspalathoides*).

(3) As noted by Armstrong (2002) plants from the 'Granite Belt' of south-east Qld and north-east NSW have 'attenuate' [narrowly triangular] sepals. These plants occur with the newly described *Z. graniticola* (see below).

***Distribution and habitat*:** *Zieria aspalathoides* subsp. *aspalathoides* is widespread in eastern Australia from Victoria through NSW, to near Atherton in north Qld (**Map 10**). It occurs in the Brigalow Belt, Einasleigh Uplands and New England Tableland bioregions. The subspecies grows in a wide range of vegetation types, but is usually found in open woodland dominated by eucalypts on a range of substrates such as sandstone, trachyte or granite.

***Phenology*:** Flowers and fruits have been collected from April to January.

***Conservation status*:** Widespread and common in Qld with populations in Blackdown Tableland, Chesterton, Girraween, Isla Gorge, Palmgrove, Precipice and Sundown National Parks. The conservation status can be assessed as **Least Concern** (IUCN 2001).

5b. Zieria aspalathoides subsp. **brachyphylla** J.A.Armstr., *Austral. Syst. Bot.* 15: 317 (2002). **Type:** Queensland. LEICHHARDT DISTRICT: Blackdown Tableland [N.P.], *c.* 35 km SE of Blackwater (campsite at old stockyard on Mimosa Creek) ... *c.* 9.5 km SW of campsite, 23°50'S, 149°00'E, 9 September 1971, *R.J.F.Henderson H1098, L.Durrington & P.R.Sharpe* (holo: BRI; iso: MEL 530477, NSW 458811).

***Additional specimen examined*:** **Queensland.** LEICHHARDT DISTRICT: Plateau above Rockland Spring *c.* 2.2 miles [3.7 km] S of Bluff, Aug 1964, *Gittins 919* (BRI, NSW).

***Notes*:** See discussion under *Z. aspalathoides*.

***Distribution and habitat*:** This subspecies is endemic to Qld where it is restricted to the Blackdown Tableland, south-east of Blackwater within the Brigalow Belt bioregion (**Map 11**). Plants have been recorded as occurring in sandy soil in crevices of sandstone outcrops in eucalypt forest.

***Phenology*:** Flowers and fruit have been collected in August and September.

***Conservation status*:** All known collections of this species were made in Blackdown Tableland N.P. though over a limited area. Known collections were made in 1966 and 1971. Surveys are required to ascertain the number of populations, number of individuals, area of occupancy and perceived threats. A conservation status of **Endangered** is appropriate based on the criteria of B2a,b(i–v) (IUCN 2001). Perceived threats are repeated destruction of populations from uncontrolled wildfires and small population sizes resulting in genetic inbreeding depression.

6. Zieria bifida Duretto & P.I.Forst., **species nova** a *Z. obovata* (C.T.White) J.A.Armstr. caule piloso vestito trichomatibus bifidis (adversum dense hirtos pilis aut simplicibus aut bifidis aut stellatis), petiolis longioribus (3–7 adversum 0–1 mm), margine folioli plus minusve plano (non recurvato), sepalis lanceolatis (adversum elliptico-ovata) et coccis glabris (in illa dense stellato-tomentosis) differens. **Typus:** Queensland. MORETON DISTRICT: Triunia National Park,

W of Woombye, 30 January 2000, *A.R.Bean 16002* (holo: BRI; iso: AD, HO 530431 [2 sheets], MEL, NSW).

Zieria sp. (Brolga Park; A.R.Bean 1002); Briggs and Leigh (1996: pp. 170, 290).

Zieria sp. (Brolga Park A.R.Bean 1002); Forster (1997b: 188; 2002: 181; 2007: 183).

***Illustration*:** Logan River Branch SGAP (QLD Region) Inc. (2005: 175) [as *Z.* sp. Brolga Park]

Shrub to 2 m tall forming an open, straggly bush. Stems erect to decumbent, spindly; branches without decurrent leaf bases, weakly glandular verrucose, pilose with mainly bifid hairs. Leaves palmately trifoliolate; petioles 3–7 mm long, pilose; terminal leaflets elliptic, narrow-elliptic or obovate, 7–20 × 3.5–8 mm, laminae weakly pellucid gland dotted, not glandular verrucose, tips acute to obtuse, margins slightly crenulate, thickened, ± flat, midrib not or slightly raised abaxially, secondary veins visible but not raised, adaxial surfaces with few simple hairs along margin, abaxial surfaces with simple or bifid hairs on margin and midrib; lateral leaflets similar to terminal leaflets but smaller, 7–17 × 1.8–7 mm. Inflorescence axillary, 1–several per axil, shorter or same length as subtending leaf, 1–several-flowered, not obviously glandular, sparsely pilose with simple, bifid or trifid hairs; peduncle 4–12 mm long; bracts linear, persistent, 0.4–3.2 mm long; secondary peduncles 1–3 mm long; pedicels 1–3.5 mm long. Sepals lanceolate, 1–2 × 0.7–0.9 mm, valvate in bud, not obviously glandular, tips acute, adaxial surfaces sparsely pilose, abaxial surfaces glabrous apart from minutely pilose margins. Petals lanceolate-elliptic, 1.8–2 × 0.8–1 mm, white, valvate in bud, not obviously glandular, adaxial surface glabrous apart from scattered stellate and bifid hairs near margin, abaxial surfaces with scattered to sparse bifid and stellate hairs along margins and especially near tip. Staminal filaments *c.* 0.8 mm long, with occasional bifid hair, eglandular; anthers *c.* 0.4 mm long, apiculum absent. Gynoecium glabrous. Cocci 2–3 × 1–1.5 mm, not glandular verrucose, glabrous, base of style sometimes persistent forming a minute apical apiculum. Seeds oblong-ovoid, 0.7–1.2 × 1–1.25 mm, black to black-purple, dull, longitudinally striated. **Fig. 3.**

***Additional specimens examined*: Queensland.** Moreton District: Brolga Park, beside Dulong road, W of Woombye [Triunia N.P.], Jan 1989, *Bean 996* (BRI); *loc. cit.*, Feb 1989, *Bean 1002* (BRI); *loc. cit.*, Dec 1989, *Bean 1193* (BRI); *loc. cit.*, Apr 1990, *Bean 1465* (BRI, MEL); Blackall Range, Brolga Environmental Park [Triunia N.P.], *c.* 6 km WNW of Nambour, Feb 1990, *Davies 1540 & Richardson* (BRI, MEL); Towen Mount road, Nambour, Jul 2003, *Moran s.n.* (BRI [AQ778097]).

***Notes*:** *Zieria bifida* is somewhat of an enigma as to its relationships, with possible morphological affinities to both *Z. exsul* and *Z. obovata*; *Z. obovata* being markedly, geographically disjunct. This new species is rather weakly formed in habit and is somewhat unusual in the predominantly bifid hairs of the indumentum. *Z. bifida* differs from *Z. obovata* in the pilose stems with bifid trichomes (versus dense-shaggy, stellate-tomentose), longer petioles (3–7 mm versus 0–1 mm), leaflet margins not recurved (versus recurved), lanceolate sepals (versus elliptic-ovate) and glabrous cocci (versus densely stellate-tomentose). *Z. exsul* differs from *Z. bifida* in the shorter petioles (2–3 versus 3–7 mm), the leaflets being densely stellate-tomentose below (versus glabrous) and with recurved to revolute margins (versus flat) and a raised midrib (versus flat or nearly so).

***Distribution and habitat*:** *Zieria bifida* is endemic to Qld and is currently known only from two localities near Nambour within the Southeast Queensland bioregion: Triunia N.P. (formerly Brolga Park) and Towen Mount road (**Map 10**). The species is found in the ecotone of rainforest (complex notophyll vineforest) and open forest of *Eucalyptus propinqua, Corymbia intermedia* and *Lophostemon confertus* on loamy soil overlying metasediments.

***Phenology*:** Flowers and fruit have been collected from December to April.

***Conservation status*:** The type locality of *Zieria bifida* is within a National Park; however, its habitat is small and under threat from fires and weed species such as *Lantana camara.* Less than 1000 plants are thought to be present with an area of occupancy less than 2 ha (A.R.Bean pers. comm. 2002). At Towen Mount road there are reputed to be 100's of

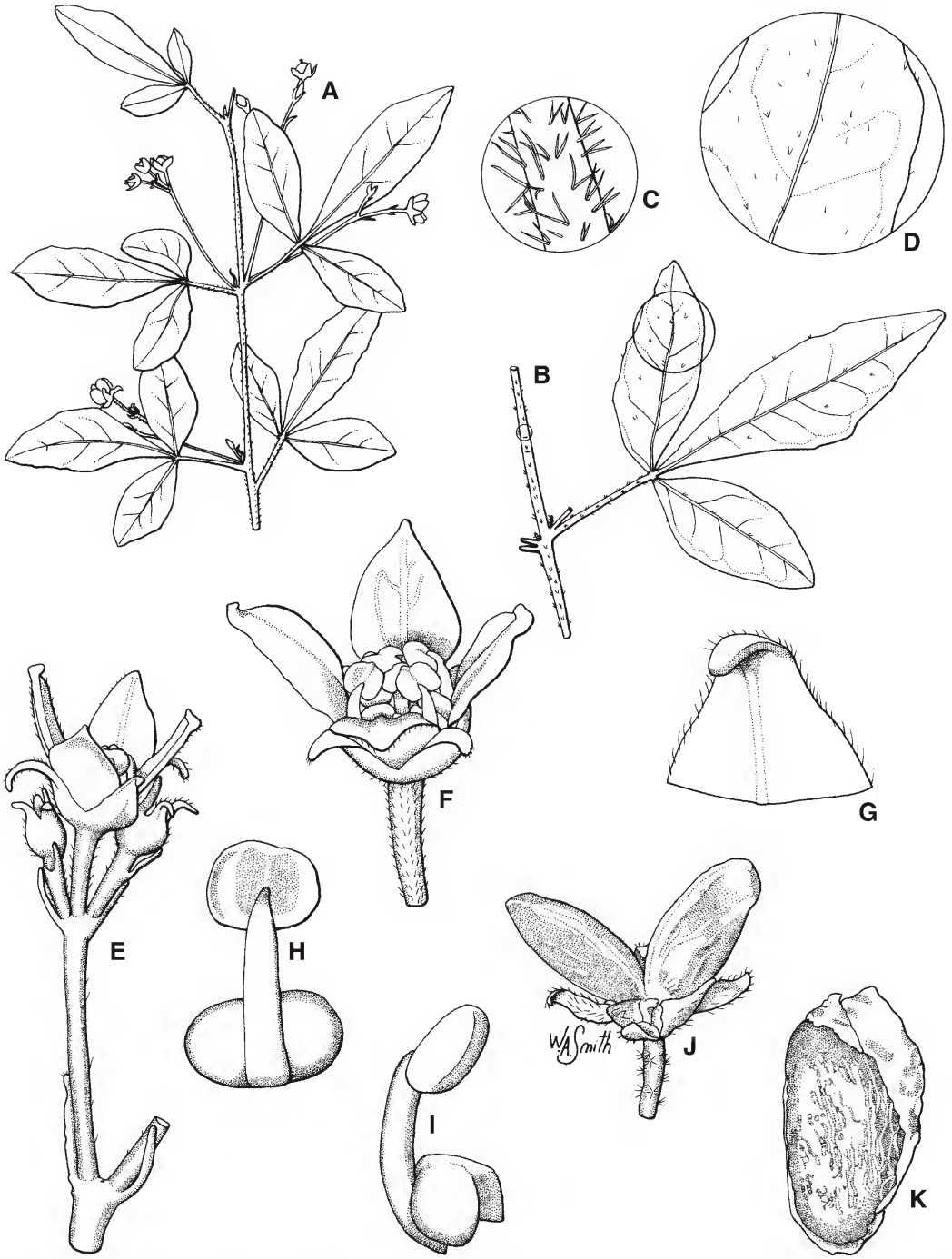

Fig. 3. ***Zieria bifida.*** A. branch with several flowering inflorescences × 1.5. B. stem node with abaxial view of leaf × 2. C. detail of indumentum on stem × 16. D. detail of indumentum on abaxial surface of leaf × 6. E. inflorescence with flower and calyces × 6. F. flower × 12. G. tip of sepal × 30. H–I. views of stamens × 30. J. mature fruit with multiple cocci × 8. K. lateral view of seed × 16. All from *Bean 16002* (BRI). Del. W. Smith.

plants (A.R.Bean pers. comm. 2006). As this species is restricted to the ecotone, then the available habitat is small and subject to rapid change from fire or the expansion of the adjacent vegetation. This species is listed as **Endangered** in Qld (*NCA* 1994).

***Etymology*:** Named for the bifid hairs that beset much of the foliage.

7. Zieria boolbunda Duretto & P.I.Forst., **species nova** a *Z. montana* J.A.Armstr. ramis manifeste glandulari-verrucosis (adversum ramos laeves) indumentum sparsum (adversum glabrum) ferentibus et floribus usque ad 7 (non 10–20+) in quaque inflorescentia differt. **Typus:** Queensland. Burnett District: 1.5 km SSW of Boolbunda Rock, 25°08′S, 151°42′E, 15 May 1986, *P.I.Forster PIF2441* (holo: BRI; iso: CANB 383722, K, MEL 1582511).

Shrub to 1 m tall forming a densely compact bush. Stems erect, wiry; branches with prominent decurrent leaf bases, glandular verrucose, with a sparse indumentum of mainly stellate hairs between decurrent leaf bases, otherwise glabrous. Leaves palmately trifoliolate; petioles 5–10 mm long, slightly glandular verrucose, adaxial surfaces with simple hairs along midrib, abaxial surfaces glabrous or glabrescent; terminal leaflets elliptic to slightly obovate, 11–25 × 3.5–8 mm, laminae slightly glandular verrucose, margins entire, flat or slightly recurved (sometimes revolute on drying), midribs raised abaxially, slightly glandular verrucose, secondary veins not raised abaxially, usually obscure, tips acute and slightly mucronate, adaxial surfaces with few hairs along midrib, abaxial surfaces glabrous or stellate glabrescent; lateral leaflets similar to terminal leaflets though usually smaller, 10–22 × 2–8 mm. Inflorescence axillary, shorter than or nearly equal to subtending leaf, usually 7-flowered though only 1–3 flowers open at any time; peduncle 4–15 mm long, slightly glandular verrucose, with a sparse stellate indumentum; bracts leaf like, persistent, to 2 mm long, glabrescent; pedicels 2.5–3 mm long, with a sparse stellate indumentum. Sepals deltate, *c.* 1.5 × 1 mm, valvate in bud, not or slightly glandular verrucose, tips acute to slightly acuminate, adaxial surfaces with scattered appressed simple hairs, abaxial surfaces glabrous or few hairs at base. Petals elliptic, *c.* 2.5 × 1.2–1.5 mm, pink-cream, dotted with pellucid glands, adaxial surfaces with a sparse to dense stellate indumentum, abaxial surfaces sparsely stellate pubescent, denser along margins. Staminal filaments *c.* 1.5 mm long, glabrous, slightly glandular or not at tip; anthers *c.* 0.6 mm long, apiculum absent. Gynoecium glabrous. Cocci *c.* 3 × 2 mm, smooth or slightly glandular verrucose, glabrous, base of style not persistent. Seeds oblong-ovoid, 2.5–2.6 × 1–1.25 mm, black, longitudinally striate. **Fig. 4.**

***Additional specimens examined*:** Burnett District: Summit of Boolbunda Rock, near Mt Perry, Aug 1986, *Bean 477* (BRI); Boolbunda Rock, *c.* 9 km NE of Mt Perry township, 25°07′S, 151°42′E, Oct 1995, *Sparshott KMS616 & Sparshott* (BRI).

***Notes*:** *Zieria boolbunda* can be distinguished from *Z. montana* by the branches being glandular verrucose (versus smooth), having a sparse indumentum (versus glabrous) and up to 7 flowers per inflorescence (versus 10–20+), and from *Z. smithii* by the prominently raised decurrent leaf bases (versus absent or very faint).

***Distribution and ecology*:** *Zieria boolbunda* is endemic to Qld and known only from Boolbunda Rock and surrounds north-east of the Mt Perry township within the Southeast Queensland bioregion (**Map 12**). It is found in clefts and crevices of granite outcrops under tall, open woodland of *Eucalyptus montivaga* with a shrubby understorey or in mountain heath with *Leptospermum*, *Alyxia* and *Lomandra* at altitudes between 600–680 m.

***Phenology*:** Flowers and fruit have been collected in May.

***Conservation status*:** This species can be locally common; however, it has a highly restricted distribution with no populations in conservation reserves. It can be assessed as **Vulnerable** on the criterion D2 (IUCN 2001). Surveys are required to ascertain the number of populations, number of individuals, the area of occupancy and any perceived threats.

***Etymology*:** The specific epithet refers to the picturesque and imposing rock this species appears to be restricted to.

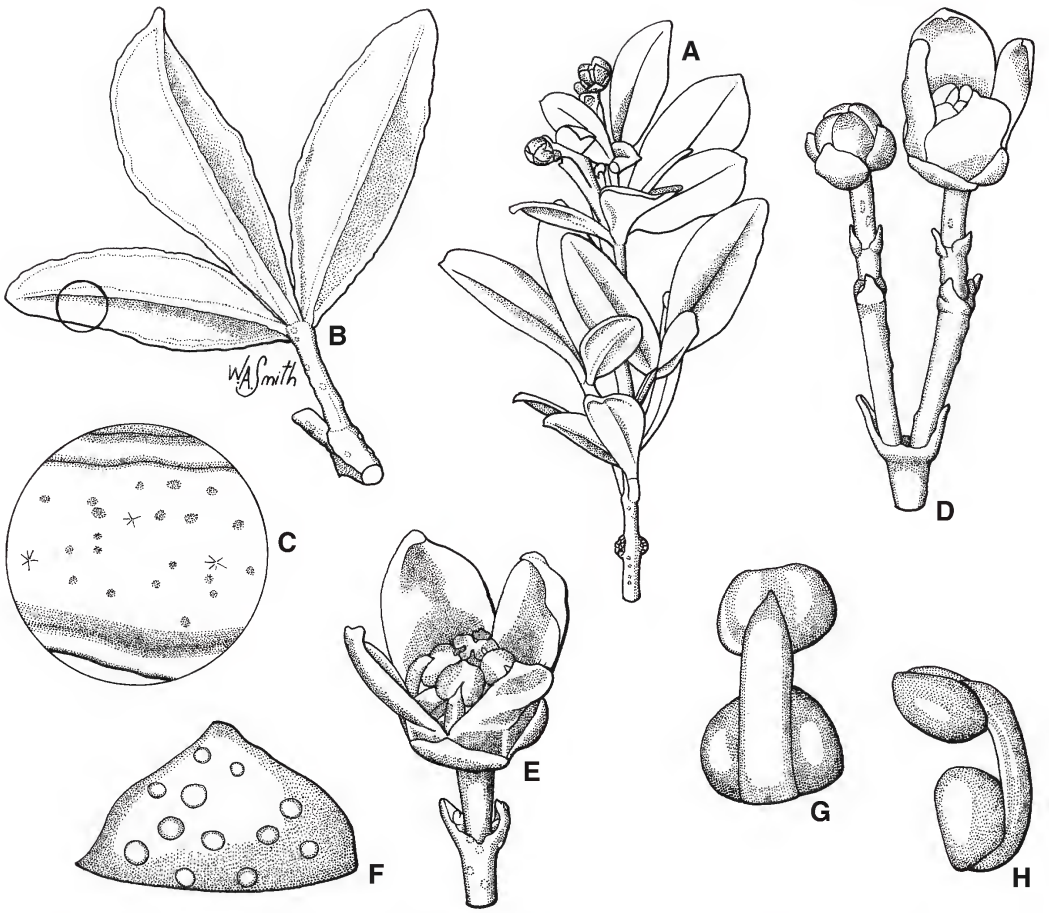

Fig. 4. ***Zieria boolbunda.*** A. branch with several budding inflorescences × 1.5. B. stem node with abaxial view of leaf × 3. C. detail of indumentum on abaxial surface of leaflet × 16. D. inflorescence with flower and bud × 6. E. flower × 8. F. tip of sepal × 20. G–H. views of stamens × 20. All from *Forster PIF2441* (BRI). Del. W. Smith.

8. Zieria cephalophila Duretto & P.I.Forst., **species nova** a *Z. compacta* C.T.White e *Z. fraseri* Hook. ramis glandulari-verrucosis (non glabris) et sparse tomentosis (adversum plerumque dense pilosos); foliis parvis glandulari-verrucosis (non glabris) foliolis stellatis glabrescentibus vel indumento sparso stellato in pagina abaxiali (adversum glabrum vel sparse pilosum) praeditis, et venis secundariis in pagina abaxiali non manifeste elevatis (adversum manifeste vel parum elevatas) differt. **Typus:** Queensland. Leichhardt District: Sydney Heads, 32 km NNW of Nebo, 21°25′S, 148°35′E, 11 November 1990, *A.R.Bean 2562* (holo: BRI).

Zieria sp. (Sydney Heads A.R.Bean 2562); Forster (2007: 183).

Shrub to 50 cm tall, forming an open compact bush. Stems erect, wiry; branches without or with slight decurrent leaf bases, prominently glandular verrucose, with a sparse indumentum of stellate hairs between the glands that is denser between the decurrent leaf bases, soon becoming glabrescent with age. Leaves palmately trifoliolate; petioles 2–3 mm long, glandular verrucose, with scattered stellate hairs; terminal leaflets narrow elliptic to narrow obovate, 11–18 × 1.5–3.5 mm, tips acute, margins revolute, midrib strongly raised abaxially and glandular verrucose, secondary veins not or weakly raised abaxially, adaxial surfaces slightly glandular verrucose, stellate glabrescent or with a sparse stellate indumentum, abaxial surfaces not glandular verrucose, densely stellate-tomentose though

not or sparingly so on midvein; lateral leaflets similar to terminal leaflets but slightly smaller. Inflorescence axillary, shorter than the subtending leaf, 1–3-flowered, glandular verrucose, with a sparse stellate indumentum; peduncle 1.5–6 mm long; bracts scale like, persistent, 0.5–1.5 mm long; pedicels 1–2.2 mm long, not or slightly glandular verrucose, sparsely to moderately-densely stellate tomentose. Sepals deltate, 1–1.5 mm long and wide, imbricate in bud, slightly glandular verrucose, tips acute, adaxial surfaces with scattered appressed simple hairs, abaxial surfaces with a moderately dense indumentum of stellate hairs. Petals narrow-elliptic, *c.* 3.5 mm long, white, aestivation unknown, not obviously glandular, both surfaces densely stellate-tomentose. Staminal filaments 0.8–1.3 mm long, glabrous or with few hairs near tip, very weakly glandular verrucose near tip; anthers *c.* 0.5 mm long, apiculum absent. Gynoecium glabrous. Cocci *c.* 2.5 × 1.5 mm, smooth, glabrous and slightly glaucous. Seeds not observed. **Fig. 5.**

***Additional specimen examined*:** Leichhardt District: SE edge of Sydney Heads, Britton Range, 6.3 km NE/ENE of Homevale Homestead [Homevale N.P.], 21°25′S, 148°35′E, May 2003, *Kemp TH7339* (BRI).

***Notes*:** *Zieria cephalophila* appears to be affiliated with *Z. compacta* and *Z. fraseri*

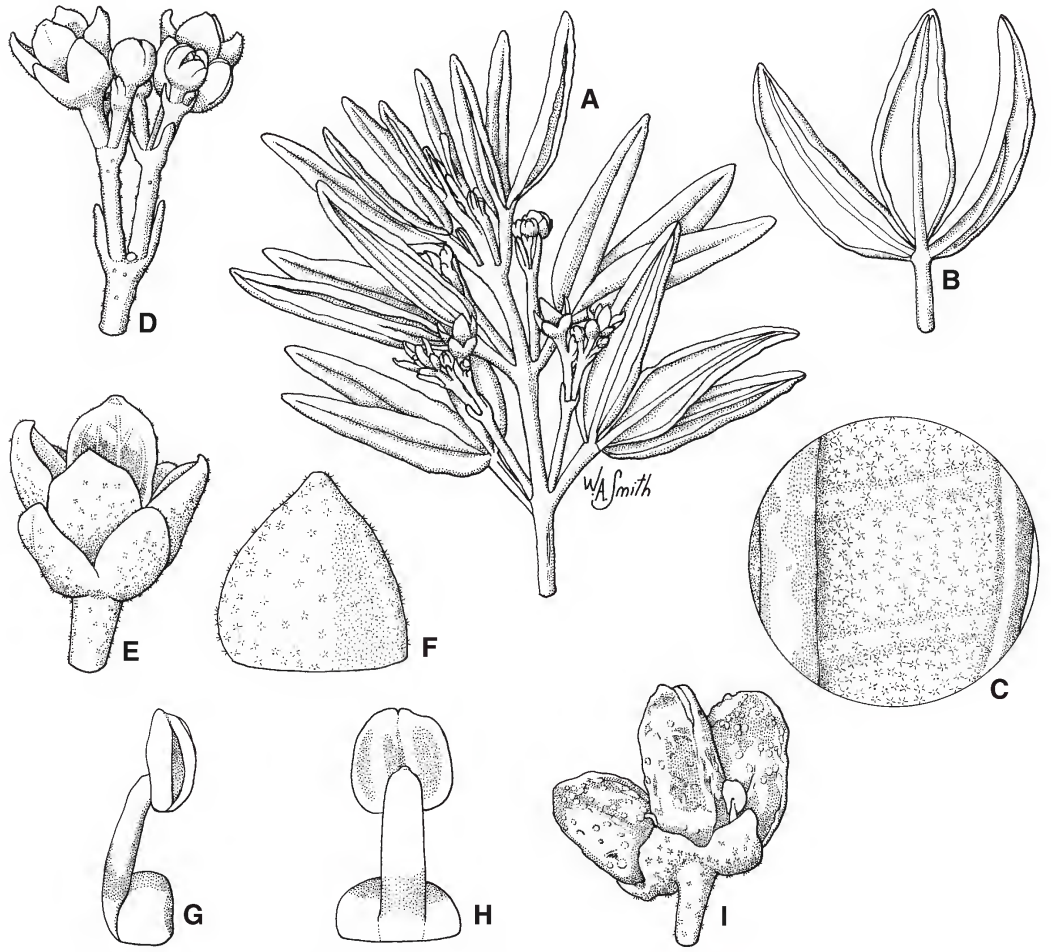

Fig. 5. ***Zieria cephalophila*.** A. branch with several budding and flowering inflorescences × 1.5. B. abaxial view of leaf × 2. C. detail of indumentum on abaxial surface of leaflet × 12. D. inflorescence with flowers and buds × 4. E. flower × 8. F. tip of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. A–H from *Kemp TH7339* (BRI), I from *Bean 2562* (BRI). Del. W. Smith.

but differs from these by the branches that are glandular verrucose (versus smooth) and sparsely tomentose (versus usually densely hairy), the leaves that are small and glandular verrucose (versus smooth), leaflets that are stellate glabrescent, or have a sparse stellate indumentum on the adaxial surface (versus glabrous or sparsely pilose), and secondary veins that are not noticeably raised on the abaxial surfaces (versus prominently or slightly raised). Like *Z. fraseri* it has leaflets with acute tips and the midvein on the abaxial surface is not densely stellate tomentose.

***Distribution and habitat*:** *Zieria cephalophila* is known from two collections made from Sydney Heads, near Nebo (**Map 6**). These specimens were collected on a rocky mountain top (tertiary acid volcanic plateau – collectors notes with *Kemp TH7339*) where it was growing in a community of *Leucopogon neoanglicus*, *Cassia* sp. and *Lophostemon confertus*, or a shrubland of *Leptospermum ?polygalifolium*, *Acacia aulacocarpa* and *Lophostemon confertus*.

***Phenology*:** Flowers and fruit have been collected in May and November.

***Conservation status*:** On the basis of the restricted distribution alone, this species can be assessed as **Vulnerable** on the criterion D2 (IUCN 2001). Populations occur within Homevale N.P.

***Etymology*:** The specific epithet is derived from the Greek *cephalus* (head) and *philus* (loving) and alludes to the populations of this plant occurring on Sydney Heads.

9. Zieria collina C.T.White, *Proc. Roy. Soc. Queensland* 43: 46/47 (1932). **Type:** Queensland. Moreton District Tamborine Mountain, 11 August 1929, *C.T.White 6155* (holo: BRI).

***Illustrations*:** Hauser & Blok (1998: 367); Armstrong (2002: 336, 337); Logan River Branch SGAP (QLD Region) Inc. (2002: 328).

***Correction to description given in Armstrong (2002)*:** Petals 1.2–2 mm long.

***Additional specimens examined*: Queensland.** Moreton District: Hayes road off Oxenford – Tamborine road, Wongawallan, 27°53′S, 153°12′E, Oct 2001, *Halford Q7044* (BRI, HO); 0.3 km past Panorama Point, Mt Tamborine, 27°54′S, 153°12′E, Jul 1999, *Bean 15234* (BRI, MEL); Wongawallan road, near Panorama Point Lookout, 27°54′S, 153°13′E, Oct 2001, *Halford Q7041 et al.* (BRI, MEL, NSW); North Tamborine Council Reserve, E end of Hartley road, 27°56′S, 153°11′E, Mar 1997, *Fitzsimmons s.n.* (BRI [AQ653204]); Mt Tamborine golf course, Mt Tamborine, 27°58′S, 153°12′E, Oct 2001, *Halford Q7043* (AD, BRI); Maybury Gully area, Canungra land Warfare Centre, 27°59′S, 153°13′E, May 1997, *Hauser s.n.* (BRI [AQ654965]); Contour road, Mt Tamborine, Mar 1976, *Sharpe 1996 & Reynolds* (BRI).

***Typification*:** Armstrong (2002) cites both *White 6155* and *White 61555* as the type collection for this name. The correct number is *White 6155*.

***Notes*:** Allied or similar appearing species are *Zieria exsul* and *Z. tenuis* (see notes there).

***Distribution and habitat*:** This species is endemic to Qld where it is restricted to Mt Tamborine and surrounds within the Southeast Queensland bioregion (**Map 11**) where it occurs in the transitional zone between 'wet' open forest and rainforest, on substrates derived from basalt or metasediments. Armstrong (2002) stated that the species was "confined to the steep narrow gulleys [sic] in Cedar Creek, Palm Grove and The Knoll National Parks on Tambourine [sic] Mountain". As predicted by Armstrong, this species has been now found in other localities, the most notable being the Canungra land Warfare Centre, which is somewhat disjunct to the main area of distribution around Mt Tamborine.

***Phenology*:** Flowers have been collected from (April) July to October (December), and fruit in December (Armstrong 2002).

***Conservation status*:** *Zieria collina* is currently listed as **Vulnerable** in Qld (*NCA* 1994). It is locally common in several populations on and near to Mt Tamborine in south-east Qld. Fitzsimmons (1999) found that the species is threatened from human-induced habitat loss and fragmentation, has restricted seed dispersal and that populations are subject to weed invasion, particularly from *Lantana camara*. The abundance of this species appears to be related to site disturbance as Fitzsimmons (1999) also found that great numbers of seedlings appeared after one of her study sites was damaged by a bulldozer. The species is present in Mt Tamborine N.P. and Clagiraba Conservation Area.

10. Zieria compacta C.T.White, *Proc. Roy. Soc. Queensland* 53: 209 (1942); *Zieria compacta* var. *compacta* C.T.White, *loc. cit* (1942); *Zieria fraseri* subsp. *compacta* (C.T.White) J.A.Armstr., *Austral. Syst. Bot.* 15: 355 (2002). **Type:** Queensland. DARLING DOWNS DISTRICT: Messines, near Stanthorpe (ex Brisbane Wild Flower Show), 13 September 1930, *C.E.Hubbard 3965* (holo: BRI).

***Illustrations*:** Armstrong (2002: 356) [as *Z. fraseri* subsp. *compacta*]; Logan River Branch SGAP (QLD Region) Inc. (2005: 174) [as *Z. fraseri*].

Shrub to 2 m tall forming a densely compact bush. Stems erect, wiry; branches without decurrent leaf bases, not obviously glandular, with a dense indumentum of mainly stellate hairs but simple and bifid hairs also present. Leaves palmately trifoliolate, not obviously glandular; petioles 3–8 mm long, with a dense indumentum of simple and stellate hairs; terminal leaflets elliptic to obovate, 11–32 × 3.5–10 mm, tips obtuse to acute, minutely apiculate, margins flat to recurved (sometimes revolute on drying), midribs strongly raised abaxially, secondary veins weakly raised abaxially, adaxial surfaces mainly glabrous with scattered simple hairs along margins and midrib or sparsely pilose all over (Bull Creek Gorge), abaxial surfaces densely stellate-tomentose including on midrib, often with scattered long simple hairs, especially along midribs; lateral leaflets similar to terminal leaflets but smaller, 8–26 × 2–9 mm. Inflorescence axillary, usually shorter than the subtending leaf (but not always), 3–20+-flowered, not obviously glandular, with a sparse to dense indumentum of simple, bifid and stellate hairs; peduncle 5–18 mm long; bracts lanceolate, often leaf-like, persistent, 1–5.5 mm long; secondary peduncles 1–10 mm long; pedicels 2–6 mm long, not obviously glandular, with a sparse to dense stellate indumentum. Sepals ovate-triangular, 1–2 × 0.8–2 mm, slightly imbricate in bud, not obviously glandular, tips acute and usually slightly inflexed, adaxial surfaces ± glabrous or with scattered simple, bifid and stellate hairs towards tip, abaxial surfaces with a sparse to moderately dense indumentum of stellate and sometimes also simple hairs, evenly spread over entire surface or only at base. Petals elliptic, 3.5–5 × 1.2–3.3 mm, white or white-pink, often drying pink, imbricate in bud, not obviously glandular, adaxial surfaces with a sparse indumentum of simple and stellate hairs, abaxial surfaces densely stellate-tomentose. Staminal filaments 1.1–1.4 mm long, glabrous or with few hairs, weakly glandular verrucose at tip; anthers *c.* 0.7 mm long, apiculum absent. Gynoecium glabrous apart from sparse to dense stellate indumentum on the inner edge. Cocci 3.5–4 × 2–2.8 mm, not glandular verrucose, with a sparse stellate indumentum on the inner edge only or all over, base of style persistent forming a minute apical apiculum. Seeds oblong-ovoid, 2.5–2.8 × 1.5–1.8 mm, brown-black, dull though striations shiny, longitudinally striate.

***Additional selected specimens examined*: Queensland.** LEICHHARDT DISTRICT: Bull Creek Gorge area, near 'Castlevale', 24°33′S, 146°42′E, Sep 1984, *O'Keeffe 655* (BRI); Bull Creek Gorge, S of Springsure – Tambo road, 24°34′S, 146°46′E, Sep 1999, *Bean 15383* (BRI, MEL, NSW); Carnarvon N.P., Mt Playfair road, 24°47′S, 146°58′E, Sep 2000, *Copeland 2674 et al.* (BRI; ex NE); Expedition N.P., NW of Taroom, Glenhaughton Gorge, 25°11′S, 149°09′E, Sep 1999, *Forster PIF24791 et al.* (AD, BRI, MEL); Expedition N.P., NW of Taroom, Spring Creek, 25°15′S, 149°08′E, Sep 2000, *Forster PIF26127 et al.* (AD, BRI, HO, MEL, NSW); Robinson Gorge N.P. [now Expedition N.P.], in Get Down section, 25°18′S, 149°10′E, Sep 1992, *Forster PIF11266 & Sharpe* (BRI); Robinson Gorge N.P. [now Expedition N.P.], in Get Down area, 25°18'S, 149°10'E, Sep 1992, *Forster PIF11399 & Sharpe* (BRI, MEL, NSW); Near Get Down, Robinson Gorge, Expedition N.P., 25°18′S, 149°10′E, Sep 1995, *Forster PIF17733 & Figg* (BRI, MEL, NSW). WIDE BAY DISTRICT: Fraser Island [unlocalised], Jun 1965, *Jones s.n.* (CANB 189291). DARLING DOWNS DISTRICT: 'Sow and Pigs', Amiens, via Stanthorpe, 28°35′S, 151°48′E, Aug 1983, *Harslett s.n.* (BRI [AQ349636], CANB); 15.7 km SW of Stanthorpe, Portion 87, Stalling lane, 28°44′S, 151°48′E, Nov 1994, *Halford Q2323* (BRI, MEL); Portion 90, Wyberba, near Girraween N.P., 28°50′S, 151°54′E, Sep 1993, *Bean 6396 & Forster* (BRI, CANB); Bald Rock Creek, Girraween N.P., 28°50′S, 151°57′E, Jun 1994, *Grimshaw PG813 & Halford* (BRI); Castle Rock, Girraween N.P., 28°51′S, 151°56′E, Sep 1993, *Bean 6339* (BRI); Ridge of Bald Mt, extreme W section of Girraween N.P., 28°52′S, 151°54′E, Sep 1994, *Grimshaw PG973 & Turpin* (BRI, NSW); Christie Target, 10 km due W of Wallangarra, 28°55′S, 151°49′E, Dec 1989, *Bean 1240* (BRI, CANB, MEL); Bald Rock Creek, near The Cascades, *c.* 10 km N of Wallangarra, 28°55′S, 151°56′E, Sep 1988, *Telford 10695* (BRI, CANB). MORETON DISTRICT: Hartmann Park, Crows Nest, 27°15′S, 152°03′E, Oct 1994, *Bean 7946* (BRI); Bungaree Environmental Park, 2 km ENE of Crow's Nest, 27°15′S, 152°04′E, Sep 1992, *Halford*

Q1501 (BRI, MEL); Helidon Hills, north of Paradise Creek, 27°26′S, 152°06′E, Sep 1993, *Sparshott 109 & Sparshott* (BRI).

***Typification*:** Armstrong (2002) did not cite a collector's number for the *Hubbard* type of *Zieria compacta* at BRI, following on from White (1942). As far as we can tell, all of Hubbard's collections that he made in Qld are numbered and it is clearly indicated on the type sheet as *Hubbard 3965*.

***Notes*:** Armstrong (2002) relegated this taxon to subspecific rank under *Zieria fraseri* and distinguished the subspecies on a number of characters. To partially reiterate Armstrong, in *Z. fraseri* he considered the central leaflets to be narrowly elliptic to narrowly obovate, the calyx lobes broadly triangular to deltate, glabrous and not noticeably inflexed adaxially at the apex, the style glabrous, the stigma not noticeably lobed and the fruit glabrous. In *Z. compacta* the central leaflets are elliptic to obovate, the calyx lobes are ovate to triangular, hirsute with stellate hairs and inflexed adaxially at the apex, the style has scattered stellate hairs, the stigma is noticeably lobed and the fruit is hirsute on the adaxial margins of cocci. Of these characters only the leaflet shape, sepal tip (though often difficult to see) and the indumentum of the cocci are useful: the other characters do not differ consistently. Despite this, there are characters that readily separate the taxa. In *Z. fraseri,* the leaflets are narrow-elliptic to narrow-obovate with recurved to revolute margins and subulate to acute tips, the midrib of the abaxial surface of the leaflets is glabrous or with an indumentum markedly less dense than that of the lamina, the pedicel is glabrous or with a sparse indumentum, the sepal tip is slightly acuminate and not inflexed, and the cocci are glabrous. In *Z. compacta* the leaflets are elliptic to obovate with a flat to recurved margin and a subacute to rounded tip, the midrib of the abaxial surface of the leaflets has an indumentum as, or nearly as dense as that of the lamina, the pedicel has a sparse to dense indumentum, the tips of the sepals are acute and inflexed (often difficult to see), and the cocci are hirsute, if only on the adaxial margin.

The two taxa do not appear to intergrade and the character differences between them justify resurrecting *Zieria compacta* at specific level, necessitating a description. *Z. compacta* is considered to be most closely allied to *Z. fraseri* (in this paper with two subspecies) and the narrowly distributed *Z. exsul* (see notes under that species).

Specimens from Bull Creek Gorge differ from the remaining specimens by being sparsely pilose all over the adaxial surface of the leaflets (versus mainly glabrous with scattered simple hairs along margins and midrib).

***Distribution and habitat*:** Armstrong (2002) provides conflicting evidence about the distribution of this taxon in Qld. In his Fig. 51 he maps it (as *Z. fraseri* subsp. *compacta*) north to the Darling Downs and Fraser Island in Wide Bay. In his notes he firstly states "from the Darling Downs District in south-eastern Queensland south to the South West Slopes of south-central NSW", then secondly "on Fraser Island it occurs in sandy areas and at Ward's Canyon, in the Carnarvon Gorge National Park", then thirdly "taxon often co-occurs with *Z. cytisoides* [e.g. in the Carnarvon Gorge National Park…".

We consider this species to be widespread in Qld within the Brigalow Belt, Southeast Queensland and New England Tableland bioregions (**Map 11**). There is a northern record from Bull Creek Gorge and populations near Crows Nest and Helidon and in the 'Granite Belt'. We have sighted one collection purported to be from Fraser Island (*Jones s.n.* [CANB 189291]); however, this record requires field confirmation. *Z. compacta* is also widespread in NSW (Armstrong 2002; Armstrong & Harden 2002).

This species usually occurs in open eucalypt forest or woodland in sandy soils over sandstone or granite, often in sheltered situations such as the base of cliffs and in gullies. At Bull Creek Gorge it is found with *Eucalyptus cloeziana, E. decorticans* and *Angophora leiocarpa*. At Expedition N.P. it is found in woodland associated with *E. cloeziana, E. mediocris, Corymbia watsoniana, C. citriodora* and

Syncarpia glomulifera. Near Crows Nest it is found with *E. montivaga, E. resinifera* and *Angophora woodsiana*. Around Girraween N.P. *Z. compacta* is found in low open forest and shrubland of *E. andrewsii*, *E. prava*, *E. youmanii* and *Allocasuarina littoralis*. In the Granite Belt the species is also found in heathland.

***Phenology*:** Flowers have been collected between August and October, and fruit in June and between September and December.

***Conservation status*:** In Qld this species is common and widespread and it is present in various conservation areas, *viz*. Carnarvon, Expedition and Girraween National Parks, and Bungaree Conservation Park. A conservation status of **Least Concern** (IUCN 2001) is recommended.

11. Zieria cytisoides Sm. in Rees, *Cyclo.* 39: no. 4 (1818). **Type**: New South Wales, 1805, *Earl St Vincent* (holo: LINN [J.E.Smith Herbarium] 214.4 [images BRI, HO 534653]).

***Illustrations*:** Armstrong (2002: 343, 344).

***Additional selected specimens examined*: Queensland.** Cook District: Mt Emerald, 17°12′S, 145°24′E, Mar 2000, *Holmes 177* (BRI, QRS). South Kennedy District: Mt Jukes N.P., *c.* 30 km NW of Mackay, 21°00′S, 148°57′E, May 1991, *Bean 3182* (BRI, CANB, NSW). Maranoa District: Slopes of Junction Ridge, N of Marlong Arch, Mt Moffatt [Carnarvon] N.P, via Injune, 24°58′S, 147°54′E, Oct 1998, *Bean 14309* (BRI, MEL, NSW). Leichhardt District: Just below the summit of Ropers Peak, NE of Capella, 22°52′S, 148°13′E, Aug 1987, *Bean 629* (BRI); Ralph's Big Rock, S.F. 34, Ruined Castle Creek catchment, NW of Taroom, 25°05′S, 149°11′E, Nov 1998, *Forster PIF23937 et al.* (BRI, MEL, NSW); Robinson Gorge N.P. [now Expedition N.P.], western base of Shepherds Peak along track to Cattle Dip, 25°19′S, 149°11′E, Sep 1992, *Forster PIF11443 & Sharpe* (BRI, MEL). Burnett District: 3 km W of 'Toondahra' Homestead, Mt Lorna, 25°59′S, 151°21′E, Aug 1988, *Forster PIF4638* (BRI, CANB, K, MO); Beeron Holding, 25°59′S, 151°21′E, Sep 1999, *Duretto 1328 et al.* (BRI, MEL); Boondooma Dam, W of Proston, 26°06′S, 151°26′E, Nov 1996, *Bean 11372* (BRI); Coomba Falls, 2 km E of Maidenwell, 26°51′S, 151°48′E, Sep 1996, *Smyrell s.n.* (BRI [AQ650117]). Darling Downs District: Johnson's Mt, 8 km from Swanfels, 33.5 km E of Warwick, 28°12′S, 152°15′E, Aug 1992, *Ballingall 2728* (BRI); Portion 90, Tartini Pty Ltd, 10.5 km NW of Ballandean, 28°45′S, 151°45′E, Dec 1994, *Halford Q2360* (BRI, NSW); Mt Jibbinbar, Sundown N.P., 34 km WSW of Stanthorpe, 28°47′S, 151°37′E, Sep 1996, *Halford Q2939* (BRI). Moreton District: E of 'Fair Hills', SW of Cooyar, 27°03′S, 151°44′E, Aug 1996, *Bean 10593* (BRI, MEL, NSW).

***Notes*:** This is a variable species in leaf morphology and indumentum density, and further critical study may result in the recognition of additional taxa. The consistent uniting characters for the species are the large pink flowers, the downy or shaggy indumentum on the foliage and the prominently raised secondary venation on the abaxial surfaces of the leaflets.

***Distribution and habitat*:** *Zieria cytisoides* occurs from Victoria through NSW into inland southern Qld in a series of closely distributed populations to a northern limit at Ropers Peak near Capella. There are also disjunct northern occurrences at Mt Jukes north of Mackay and Mt Emerald near Atherton. It is present within the Brigalow Belt, New England Tableland and Southeast Queensland bioregions (**Map 8**). It is much more widespread in Qld than indicated by Armstrong (2002). *Z. cytisoides* grows in skeletal soils derived from granite, sandstone or trachyte substrates in open eucalypt woodland, shrubland or heathland. Associated canopy species in the open woodland may include *Angophora leiocarpa, Corymbia citriodora, C. hendersonii, C. watsoniana, Eucalyptus cloeziana, E. decorticans* and *Lysicarpus angustifolius*.

***Phenology*:** Flowers have been collected from August to October and in March, and fruit from October to December and in March and May.

***Conservation status*:** This species is common and widespread and is present in several National Parks, including Carnarvon, Expedition, Mt Jukes and Sundown. A conservation status of **Least Concern** (IUCN 2001) is recommended.

12. Zieria distans Duretto & P.I.Forst., **species nova** *Z. verrucosae* J.A.Armstr. affinis sed foliolis multo minoribus aut patentibus aut erectis (non cernuis) et anguste ellipticis (non linearibus) ratione longitudinis latitudini minore (3.6–10.1 adversum 10–25.3), inflorescentiae bracteis linearibus (adversum anguste oblongas) et sepalis dense (non dispersis) glandulari-verrucosis differt. **Typus:** Queensland. Burnett District: Mt Walla, Walla Range, 5 km SW of Coalstoun Lakes, 12 September 2002, *P.I.Forster*

PIF28835 (holo: BRI [2 sheets + spirit]; iso: A, AD, HO 530418 [3 sheets], L, MEL, NSW, NY, Z distribuendi).

Shrub to 1.5 m tall forming an open, straggly bush. Stems erect, wiry; branches without decurrent leaf bases, glandular verrucose, densely stellate-tomentose on very young branches only, otherwise glabrescent or glabrous. Leaves palmately trifoliolate; petioles 5–12 × 0.6–0.7 mm, glandular verrucose, minutely pilose or glabrous; terminal leaflets narrow-elliptic, (8–) 11–30 (–37) × 1–4.5 mm, laminae weakly glandular verrucose on adaxial surfaces, margins and abaxial midribs, tips obtuse to acute, margins entire and slightly recurved, sometimes becoming revolute on drying, midribs raised abaxially, secondary veins obscure, adaxial surfaces glabrous except for a few simple or stellate hairs along midrib and near base, abaxial surfaces densely stellate tomentose except for midribs; lateral leaflets similar to terminal leaflets and may be larger or smaller; leaflet length/width ratio 3.6–10.1. Inflorescence axillary, shorter than the subtending leaf, 12–21+-flowered, glandular verrucose apart from flowers, with a scattered to dense indumentum of simple and stellate hairs; peduncle 2–8 mm long; bracts linear, persistent, 0.5–1.5 (–3.5 Mt Roberts & Walla Range) mm long; secondary peduncles 2–4 mm long; pedicels 1–2.5 mm long, weakly glandular verrucose, densely stellate-tomentose. Sepals ovate-triangular, 1–1.2 × 0.5–0.8 mm, imbricate in bud, glandular verrucose, tips acute, adaxial surfaces glabrescent, abaxial surfaces densely stellate-tomentose at base, otherwise glabrescent between glands. Petals elliptic, 1.8–3 × 1–1.5 mm, white, imbricate in bud, not obviously glandular, tips acute, adaxial and abaxial surfaces stellate tomentose. Staminal filaments *c.* 1 mm long, glabrous or with few scattered minute hairs, eglandular; anthers *c.* 0.5 mm long, apiculum absent. Gynoecium glabrous. Cocci *c.* 3.5 × 0.5 mm, not or slightly glandular verrucose, glabrous, base of style persistent forming a minute apical apiculum. Seeds not observed. **Fig. 6.**

***Additional specimens examined*: Queensland.** Port Curtis District: *c.* 9 km NE of Miriam Vale, Westwood Range [Eurimbula N.P.], 24°16′S, 151°37′E, Jul 1996, *Thompson MIR173 & Price* (BRI); Kroombit Tops N.P., western section, 24°21′S, 150°52′E, Aug 1995, *Thompson BIL132 & Turpin* (BRI, MEL); Kroombit Tops N.P., western section, 24°25′S, 150°53′E, Aug 1995, *Thompson BIL105 & Turpin* (BRI); Kroombit Tops N.P., western section, 24°27′S, 150°54′E, Aug 1995, *Thompson BK140 & Manders* (BRI); Kroombit Tops N.P., 24°27′S, 150°59′E, Dec 1996, *Brushe JB672* (BRI); T.R. 353, Mt Roberts, 24°30′S, 151°16′E, *Thompson MON1 & Turpin*, Jul 1995 (BRI, HO). Burnett District: western slope of Walla Range, 25°38′S, 151°50′E, Jun 1996, *Grimshaw PG2460 & Turpin* (BRI); 3 km SW of Coalstoun Lakes, Walla Range, 25°38′S, 151°51′E, Aug 1990, *Randall 611* (BRI); Coalstoun Lakes shop [actually Walla Range], 25°39′S, 151°50′E, Jun 1994, *Thomas 320 & Sinclair* (BRI); Coongara Rock, N face near summit, 25°39′S, 151°58′E, May 1996, *Grimshaw PG2396 & Baumgartner* (BRI, CANB); Southern base of Coongara Rock, 11 km ESE of Coalstoun Lakes, 25°39′S, 151°59′E, Sep 2002, *Forster PIF28843* (BRI, HO, MEL, NE, NSW); Coongara Rock, 11 km ESE of Coalstoun Lakes Township, 25°39′S, 151°58′E, Nov 2002, *Forster PIF29104* (BRI); *loc. cit.*, Dec 2002, *Forster PIF29192* (BRI, MEL, NSW).

***Notes*:** Together with *Zieria vagans* and *Z. verrucosa*, this species forms a trio of closely related and similar appearing taxa. While all three species are immediately recognisable on gross morphology from dried specimens, it is necessary to be observant as to the distribution of hairs and glands on the foliage and flowers, as well as the shape and dimensions of the leaflets. *Z. distans* is a much smaller plant than the other two species and has noticeably smaller foliage. It differs from *Z. verrucosa* in the much smaller leaves that are held patently or erect (versus drooping), the leaflets that are narrow-elliptic (versus linear) and with a length/width ratio of 3.6–10.1 (versus 10–25.3), the linear inflorescence bracts (versus narrow-oblong) and the sepals being densely beset with glands (versus scattered). *Z. distans* differs from *Z. vagans* in the broader leaflets with a length/width ratio of 3.6–10.1 (versus 7.5–10.8) and that have the midrib ± glabrous to sparsely indumented below (versus woolly stellate-tomentose), the leaf-bearing branchlets being glabrescent to sparsely and minutely stellate tomentose between glands (versus woolly stellate-tomentose all over), the linear inflorescence bracts (versus narrow-oblong) and the base of the sepals being stellate tomentose abaxially, including on the glands (versus glabrescent between glands).

***Distribution and habitat*:** *Zieria distans* is endemic to Qld and has been collected from Walla Range near Coalstoun Lakes, Coongara Rock, Kroombit Tops, Westwood Range and the Mt Roberts area within the Southeast Queensland bioregion (**Map 5**). In all habitats it is an inhabitant of clefts and crevices in rocky situations. At Kroombit Tops the species has been collected on rhyolitic rock pavements with *Triplarina volcanica*, and at Mt Roberts in tall open shrubland of *Lophostemon confertus* with much bare rock (granodorite). At Mt Walla the plants occur in an ecotone between woodland of *Corymbia citriodora* subsp. *variegata* and fragmented semi-evergreen vinethicket on rhyolitic ignimbrite. At Coongara Rock, the plants occur on rock faces or rubble at the base of clifflines, once again on rhyolitic ignimbrite, in woodland of *Araucaria cunninghamii* and

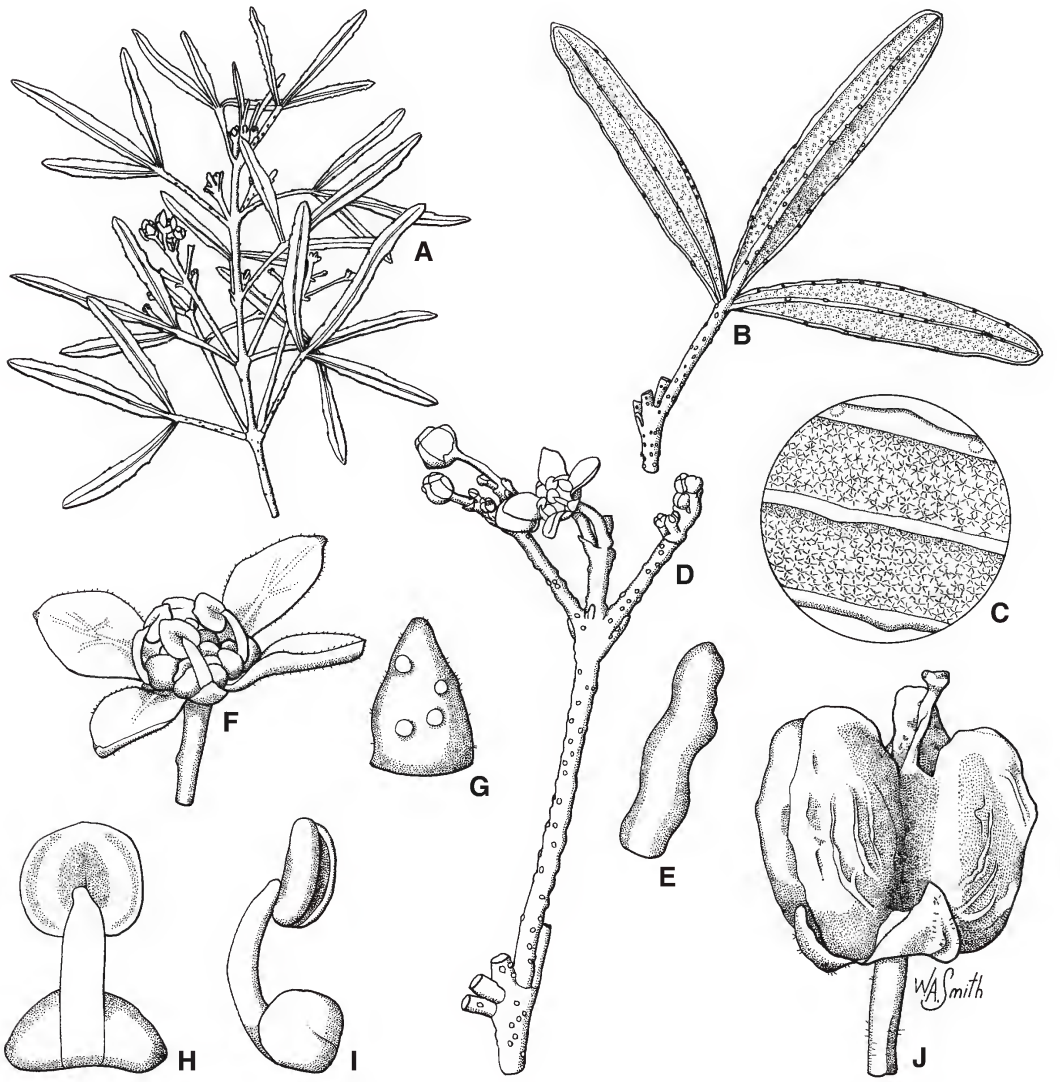

Fig. 6. *Zieria distans*. A. branch with several flowering inflorescences × 1. B. stem node with abaxial view of leaf × 2. C. detail of indumentum on abaxial surface of leaflet × 20. D. inflorescence with buds & flower × 3. E. inflorescence bract × 20. F. flower × 8. G. tip of sepal × 20. H–I. views of stamens × 20. J. mature fruit with multiple cocci × 16. A from *Forster PIF28853* (BRI); B & J from *Forster PIF29192* (BRI); C–I from *Forster PIF28835* (BRI). Del. W. Smith.

Acacia blakei or *Corymbia citriodora* and *Eucalyptus acmenoides*.

***Phenology*:** Flowers have been collected from May to September, and fruit in December.

***Conservation status*:** The populations at Kroombit Tops N.P. and Westwood Range (in Eurimbula N.P.) are probably reasonably conserved and those at Coongara Rock and Mt Roberts are within State Forests and Timber Reserves. The population at Walla Range is on private land and is not conserved. At this site, *Z. distans* occurs in close proximity to populations of the endangered *Pomaderris clivicola* E.M.Ross and *Phebalium distans* P.I.Forst. It is possible that thousands of plants occur at Kroombit Tops, and several hundred at Walla Range and Coongara Rock. However, in all instances the populations are relatively restricted and some (e.g. Walla Range) are subjected to regular catastrophic disturbance by fires fuelled by exotic grass species. This species can be assessed as **Near Threatened** on the basis of criterion D (IUCN 2001). Surveys are required to ascertain the number of populations, number of individuals and the area of occupancy.

***Etymology*:** The epithet is derived from the Latin *distans* (being apart, well separated), and alludes to the disjunct populations of this species that occur on the tops of mountains or ranges.

13. Zieria eungellaensis Duretto & P.I.Forst. **species nova** a *Z. montana* J.A.Armstr. foliolis minoribus, 3–16 mm longis (non 20–45 mm) et floribus paucioribus (1–3 adversum magis quam 10) in quaque inflorescentia differt. **Typus:** Queensland. South Kennedy District: Mt William, Eungella Range [Eungella National Park], 21°01′S, 148°36′E, 8 August 1978, *P.Hind 2263* (holo: BRI; iso: MEL 2189242, NSW 458969).

***Illustrations*:** Pearson & Pearson (1992: 214) [as *Z.* sp. nov. (Mt William)]; Armstrong (2002: 399, Fig. 86c) [as *Z. montana*].

Shrub to 2 m tall forming an openly compact bush. Stems erect, wiry; branches with prominent decurrent leaf bases, conspicuously scarred from fallen buds and leaves, not or faintly glandular verrucose, glabrous (Mt William & Mt Dalrymple) or with a moderately dense indumentum of simple, bifid and mainly stellate hairs (Mt David), older branches becoming glabrous, sometimes older branches becoming lenticellate and corky. Leaves palmately trifoliolate, glabrous or glabrescent along midvein (Mt William & Mt Dalrymple) or with a sparse indumentum of simple and bifid hairs that is denser on the midribs (Mt David); petioles 2–8 mm long, very slightly glandular verrucose; terminal leaflets elliptic to obovate, 5–14 (–16 Mt David) × 3–8 mm, laminae not glandular verrucose, tips obtuse (Mt William & Mt Dalrymple) or acute (Mt David), margins flat and crenulate, flat (can become revolute on drying), midveins raised abaxially, secondary veins obscure; lateral leaflets similar to terminal leaflets though usually slightly smaller, 3–13 × 2–8 mm. Inflorescence axillary, shorter than the subtending leaf, 1–3-flowered, not glandular verrucose, glabrous or glabrescent (Mt William & Mt Dalrymple) or with a sparse to moderately dense indumentum of mainly simple and bifid hairs (Mt David); peduncle 1–3 mm long,; bracts scale like, persistent, not or slightly glandular verrucose; pedicels 1–2.5 mm long. Sepals deltate, 0.7–0.8 × 0.6–1 mm, valvate in bud, tips acute, glabrous (Mt William & Mt Dalrymple) or adaxial surfaces with scattered appressed hairs and abaxial surfaces with a sparse indumentum of simple and bifid hairs concentrated near base (Mt David), abaxial surfaces slightly glandular verrucose. Petals elliptic, 2.5 (Mt David)–3.5 (Mt William & Mt Dalrymple) × 1.2–1.5 mm, white to pink, valvate in bud, dotted with pellucid glands, adaxial surfaces with dense stellate indumentum, abaxial surfaces with a sparse stellate indumentum though pubescent along margins (Mt William & Mt Dalrymple) to moderately dense stellate indumentum (Mt David). Staminal filaments *c.* 1 mm long, glabrous or with scattered simple hairs, not or slightly glandular distally; anthers *c.* 0.7–1 mm long, apiculum absent. Gynoecium glabrous. Cocci 2.5–3.5 × 2–2.5 mm, smooth, glabrous, base of style persistent forming a minute apical apiculum. Mature seeds not observed. **Fig. 7.**

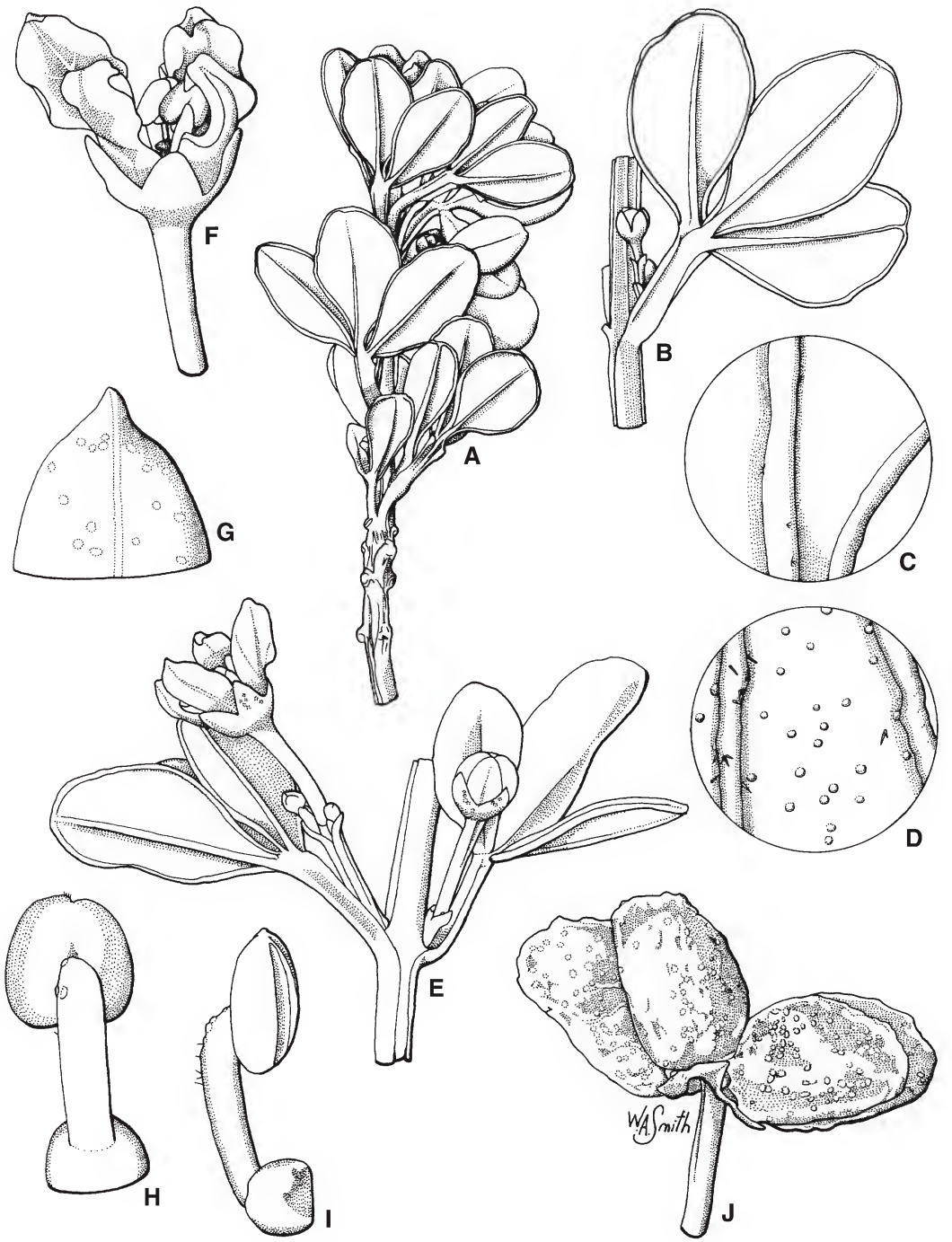

Fig. 7. *Zieria eungellaensis*. A. branch with several flowering inflorescences (obscured by leaves) × 2. B. stem node with abaxial view of leaf × 4. C–D. detail of indumentum variation on abaxial surface of leaflets from different localities × 20. E. stem node with two inflorescences with bud and flower × 4. F. flower × 8. G. tip of sepal × 20. H–I. views of stamens × 20. J. mature fruit with multiple cocci × 8. A–C from *Hind 2263* (BRI); D & J from *Bean 4435* (BRI); E–I from *Bean 4444* (BRI). Del. W. Smith.

***Additional specimens examined*: Queensland:** South Kennedy District: Mt William, Eungella N.P., Aug 1984, *McDonald 2* (BRI); *loc. cit.*, Aug 1989, *Pearson 45* (BRI); *loc. cit.*, May 1992, *Bean 4444* (BRI); N.P.R. 573, Mt William, 21°00′S, 148°35′E, *s.dat.*, *Hanson EUN116P* (NSW); *loc. cit.*, 20°01′S, 148°36′E, Apr 1981, *Hyland 11010* (NSW); Clarke Range, Eungella N.P., Mt Dalrymple, 21°02′S, 148°38′E, Apr 1991, *Telford 11165 & Rudd* (CANB); WSW of Mt David, Eungella N.P., 21°02′S, 148°37′E, May 1992, *Bean 4435* (BRI, HO, MEL).

***Notes*:** Specimens of *Zieria eungellaensis* were included under a broadly circumscribed *Z. montana* by Armstrong (2002). The latter species is now considered to be restricted to Mt Barney in SE Qld and *Z. eungellaensis* differs in the smaller leaflets (3–16 mm long; *cf.* 20–45 mm long) and by having fewer flowers per inflorescence (1–3; *cf.* >10).

Zieria eungellaensis appears to have two variants: a glabrous or glabrescent variant from Mt William and Mt Dalrymple and a hirsute variant from nearby Mt David (see description above). The material from Mt David also has leaflets with acute tips as compared to the obtuse tips found on the material from the other two areas. The hirsute stems are similar to those found in *Z. robertsiorum* from the Wet Tropics bioregion. Material from Mt David differs from *Z. robertsiorum* in having an indumentum of mainly simple hairs on the leaves (versus stellate) and the tips of the leaflets being acute (versus obtuse). Field and laboratory research is required to determine if the variation seen in *Z. eungellaensis* warrents taxonomic recognition. Any field research should include surveys of other localities in the Eungella area similar to where these taxa have been collected.

***Distribution and habitat*:** *Zieria eungellaensis* is endemic to Qld and appears to be confined to the Clarke Range where it is known from a few collections from the Mt William summit area (*c.* 1250 m), and single collections from both Mt Dalrymple (*c.* 1300 m), and Mt David (*c.* 1250 m), Eungella N.P.; all within the Central Queensland Coast bioregion (**Map 5**). The species is found in windswept heath on decomposed granitic soil where it grows in clefts and crevices and small patches of dense vegetation. Associated taxa include species of *Hakea*, *Banksia*, *Acacia*, *Hibbertia*, *Acrotriche*, *Leucopogon*, *Gonocarpus* and *Rhodomyrtus*.

***Phenology*:** Flowers have been collected in May and August, and fruit in April and August.

***Conservation status*:** No population data was given with the specimens made on Mt William and Mt David though collector's notes with *Telford 11165* indicate that it was rare on Mt Dalrymple. All known collections were made within Eungella N.P. A conservation status of **Vulnerable** based on the D2 criterion (IUCN 2001) can be allocated to this taxon purely on the limited distribution and apparent small population size. Survey work is required to determine the number of populations, number of individuals, area of occupancy and perceived threats.

***Etymology*:** The specific epithet refers to the National Park this species appears to be endemic to.

14. Zieria exsul Duretto & P.I.Forst., **species nova** *Z. compacta* C.T.White caulis indumento divaricato (in illa antrorso), foliorum indumento simplici sparso (adversum glabrum vel rarius pilosum), inflorescentia glabra (adversum indumentum sparsum usque densum), petalis brevioribus (2–2.5 non 3.5–5 mm) et coccis glabris (in illa indumento stellato in acie interiore praeditis) differens. **Typus:** Queensland. Moreton District: Sugarbag road, Caloundra, 16 March 1997, *A.R.Bean 11773* (holo: BRI; iso: MEL 306832, NSW).

Zieria sp. (Mooloolaba G.Leiper AQ636552); Forster (2002: 181; 2007: 183).

***Illustration*:** Logan River Branch SGAP (QLD Region) Inc. (2005: 176) [as *Z.* sp. Mooloolaba].

Shrub to 60 cm tall forming an open, straggly bush. Stems erect to decumbent, spindly; branches without decurrent leaf bases, not obviously glandular, with a sparse to moderately dense indumentum of simple, bifid to stellate hairs. Leaves palmately trifoliolate, not obviously glandular though weakly pellucid gland dotted; petioles 2–3 mm long, sparsely pilose; terminal leaflets

obovate, 10–16 × 2.5–5 mm, tips acute to apiculate, margins recurved to revolute, midrib and some secondary veins raised abaxially, adaxial surfaces sparsely pilose, abaxial surfaces densely stellate tomentose; lateral leaflets similar to terminal leaflets but smaller, 5–12 × 2–4 mm. Inflorescence axillary, longer than the subtending leaf, 1–12-flowered, not or weakly glandular verrucose, glabrous; peduncle 10–19 mm long; bracts linear-lanceolate, persistent, 2–2.5 mm long; secondary peduncles 3–10 mm long; pedicels 1.3–2.5 mm long, not obviously glandular, glabrous and slightly glaucous. Sepals ovate-triangular, 1–1.2 × 0.8–1 mm, valvate in bud, not glandular tuberculate, tips acute and inflexed, adaxial surfaces minutely pilose, becoming glabrous towards centre, abaxial surfaces glabrous and slightly glaucous. Petals elliptic, 2–2.5 × *c.* 1.5 mm, white though drying pink, valvate in bud, not obviously glandular, adaxial surfaces minutely pilose, abaxial surfaces densely stellate-tomentose. Staminal filaments *c.* 0.7 mm long, glabrous, eglandular; anthers *c.* 0.5 mm long, apiculum absent. Gynoecium glabrous. Cocci 3–5 × 2–2.5 mm, slightly glandular verrucose, glabrous, base of style persistent forming a minute apical apiculum. Seeds oblong-ovoid, 2.8–3 × 1.4–1.5 mm, longitudinally striate, dark-brown. **Fig. 8.**

***Additional specimens examined*: Queensland.** Moreton District: along old Mooloolaba Bypass road, *c.* 300 m S of Buderim road intersection, Jan 1993, *Leiper s.n.* (BRI [AQ561989]); Intersection of Mooloolaba–Buderim road and new toll road to Kawana, Jan 1995, *Leiper s.n.* (BRI [AQ636552]); *loc. cit.*, Sep 2002, *Leiper s.n.* (BRI); Buderim, near Sunshine motorway, Aug 1996, *Patterson s.n.* (BRI [AQ652665]); Buderim, adjacent to Sunshine motorway and corner of Mooloolabah road, 26°41′S, 153°06′E, Oct 2002, *Forster PIF28967* (BRI, HO, MEL, NSW).

***Notes*:** *Zieria exsul* appears to be closely allied to *Z. compacta* but differs in the stem indumentum being divaricate (versus antrorse), the adaxial surface of the leaves with a sparse, simple indumentum (versus glabrous usually, rarely sparsely pilose), the glabrous inflorescence (versus with sparse to dense indumentum), the shorter petals (2–2.5 mm versus 3.5–5 mm long) and the cocci glabrous (versus with sparse stellate hairs on the inner edge). *Z. exsul* is always a weak, spindly subshrub with inflorescences that are markedly longer than the subtending leaf, whereas in nearly all cases *Z. compacta* is a somewhat woody erect bush and has the inflorescence either shorter or as long as the subtending leaf. There are however the occasional exceptions to these latter characters (at least in *Z. compacta*) so they are not reliably diagnostic.

***Distribution and habitat*:** *Zieria exsul* is endemic to Qld and has been collected from two localities (both roadside remnants), near Buderim and Caloundra within the Southeast Queensland bioregion (**Map 5**). This species has been found in wallum heathland as well as woodland of *Corymbia trachyphloia*, *Eucalyptus siderophloia*, *E. racemosa*, and *Allocasuarina littoralis*. At the Buderim locality it co-occurs with *Z. minutiflora* subsp. *minutiflora*.

***Phenology*:** Flowers have been collected in March, September and October, and fruit in March.

***Conservation status*:** This species was known from only two populations and the total number of plants is less than 100. The Buderim population has been bisected and ± destroyed by recent motorway extensions and powerline maintenance work. At the Caloundra locality only 10 plants were noted in 1997. There has been widespread destruction of wallum heathland in the area between Buderim and Caloundra, both for agriculture, forestry plantations, housing and tourist developments. The species can be assessed as **Critically Endangered** under the IUCN categories of A1(a),(c), 3; B2b(i–v) (IUCN 2001).

***Etymology*:** The specific epithet is derived from the Latin word *exsul* (banished, exile) and alludes to plants of this species having been destroyed over much of its probable former range.

15. Zieria fraseri Hook. in T.L.Mitchell, *J. Exp. Int. Trop. Australia* 339 (1848); *Zieria laevigata* Sm. var. *fraseri* (Hook.) Domin, *Repert. Spec. Nov. Regni. Veg.* 12: 133 (1913). **Type:** Queensland. Moreton District: Mt Lindesay [actually Mt Barney], *C.Fraser s.n.*

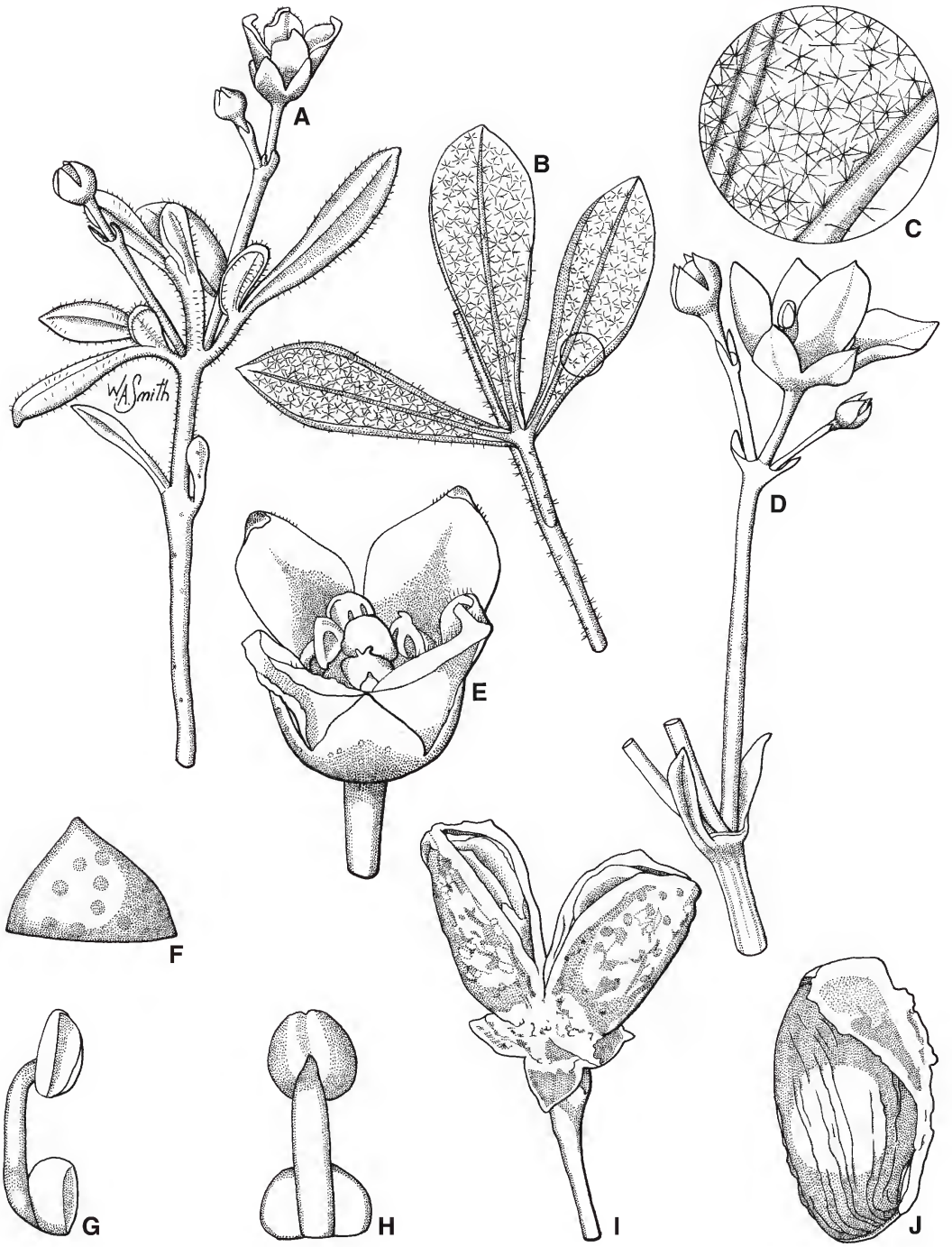

Fig. 8. *Zieria exsul*. A. branch with several flowering inflorescences × 4. B. stem node with abaxial view of leaf × 4. C. detail of indumentum on abaxial surface of leaflet × 20. D. inflorescence with buds and flower × 6. E. flower × 12. F. tip of abaxial side of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. J. lateral view of seed × 12. A, E–H from *Forster PIF28967* (BRI); B–D from *Bean 11773* (BRI); I–J from *Leiper s.n.* (BRI). Del. W. Smith.

(holo [*fide* Armstrong 2002: 352]: K 347899 [images BRI, HO 534656]).

Shrub to 2 m tall forming a densely compact bush. Stems erect, wiry; branches without decurrent leaf bases, not obviously glandular, glabrous (subsp. *robusta*) or with a sparse (subsp. *robusta*) to dense indumentum of stellate, simple and bifid hairs. Leaves palmately trifoliolate, not obviously glandular; petioles 2–10 mm long, with a sparse to dense indumentum of simple and stellate hairs; terminal leaflets narrow elliptic to narrow obovate, 8–51 × 1–8 mm, tips acute, margins recurved to revolute, midribs strongly raised abaxially, secondary veins not or weakly raised abaxially, adaxial surfaces mostly glabrous with a few scattered hairs along midrib and margins, abaxial surfaces densely stellate-tomentose though midribs almost glabrescent or with a sparse to moderately dense indumentum (epidermous clearly visible); lateral leaflets similar to terminal leaflets though usually smaller, 7–50 × 1–8 mm. Inflorescence axillary, shorter or longer than the subtending leaf, 3–20^{+}-flowered, not obviously glandular, glabrous or with a sparse to moderately dense indumentum of simple, bifid and stellate hairs, sometimes glaucous; peduncle 4–37 mm long; bracts lanceolate, often leaf-like, persistent, 1–20 mm long; secondary peduncles 1–15 mm long; pedicels 2–6 mm long, glabrous, stellate glabrescent or with a sparse to moderately dense stellate indumentum. Sepals ovate-triangular, sometimes broadly so, 1.5–2.1 × 1.5–2.1 mm, slightly imbricate in bud, not obviously glandular, tips acute to acuminate, straight, adaxial surfaces with scattered simple and stellate hairs mainly towards tip, abaxial surfaces glabrous or with a few stellate hairs at base, sometimes glaucous. Petals elliptic, 2.5–6 × 1.5–4 mm, white to pink, imbricate in bud, not obviously glandular, adaxial surfaces with a sparse to dense indumentum of simple and stellate hairs, abaxial surfaces densely stellate-tomentose. Staminal filaments 1–1.5 mm long, glabrous or with few hairs, weakly glandular verrucose at tip; anthers 0.7–1 mm long, apiculum absent or present. Gynoecium glabrous. Cocci 3.5–4.5 × 2.5–3.2 mm, not glandular verrucose, glabrous, base of style persistent forming a minute apical apiculum. Seeds (seen for subsp. *robusta* only) oblong-ovoid to ovoid, 2.1–3.1 × 1.2–1.75 mm, black, shiny, striate.

***Typification*:** Charles Fraser probably collected the type of *Zieria fraseri* on the present day Mt Barney as both he and Alan Cunningham misnamed this peak as Mt Lindesay (Telford 1990; Forster 1994b). This species has not been collected on Mt Lindesay to date.

***Notes*:** As circumscribed by Armstrong (2002), *Zieria fraseri* comprised two subspecies: subsp. *fraseri* and subsp. *compacta*. Armstrong considered that subsp. *fraseri* was markedly disjunct in Qld with populations at the Blackdown Tableland (named by White (1942) as *Z. compacta* var. *glabrata* and *Z. compacta* var. *robusta*) and populations in the Moreton District on the 'Scenic Rim'. For the other subspecies that he recognised (*Z. fraseri* subsp. *compacta*) we have resurrected *Z. compacta* at specific rank (see earlier).

It is considered that *Zieria compacta* var. *glabrata* and *Z. compacta* var. *robusta* are conspecific with *Z. fraseri,* but that a single taxon based on these two varieties and distinguishable on leaf characters and floral size can be recognised as a disjunct subspecies of *Z. fraseri*.

Key to the subspecies of *Z. fraseri*

1. Inflorescence shorter than the subtending leaf (rarely longer and then pedicel with a dense indumentum); branches hirsute; pedicel glabrescent or sparsely to densely indumented; anther apiculum absent . . . . . subsp. **fraseri**
   Inflorescence longer than the subtending leaf (rarely shorter and then pedicel and/or branches glabrous); branches glabrous or hirsute; pedicel glabrous or sparsely indumented; anther apiculum absent or present . . . subsp. **robusta**

15a. Zieria fraseri Hook. subsp. **fraseri**

***Illustrations*:** Armstrong (2002: 308); Logan River Branch SGAP (QLD Region) Inc. (2002: 328).

Shrub to 1 m tall; young branches with a dense indumentum of mainly stellate hairs but simple and bifid hairs also present. Petioles 2–6 (–10 Mt Ernest) mm long, with a dense indumentum of simple and stellate hairs; terminal leaflets 8–38 × 1–6 mm wide; lateral leaflets 7–34 × 1.5–6 mm. Inflorescence axillary, shorter (very rarely longer and then barely, Mt Ernest) than the subtending leaf, 3–12-flowered, with a moderately dense indumentum of simple, bifid and stellate hairs; peduncle 4–15 (–25 Mt Ernest) mm long; bracts 1–3.5 (–12 Mt Ernest) mm long; secondary peduncles 1–8 mm long; pedicels 2–4 mm long, stellate glabrescent or with a sparse to moderately dense stellate indumentum. Sepals ovate-triangular, 1.5–2 × 1.5–1.75 mm, abaxial surface glabrous or with stellate hairs at base. Petals 2.5–4.5 × 1.5–2 mm. Staminal filaments glabrous or with a few hairs; anther apiculum absent. Cocci 3.5–5 × 2.5–3 mm. Mature seeds not seen.

***Additional selected specimens examined*: Queensland.** Moreton District: Northern slopes of Mt Maroon [Mt Barney N.P.], 28°12′S, 152°43′E, May 1990, *Forster PIF6834 et al.* (BRI, MEL); Mt Maroon, 28°12′S, 152°43′E, Sep 1994, *Forster PIF15710* (BRI); Mt Maroon, SE side, 28°12′S, 152°43′E, Sep 1996, *Leiper s.n.* (BRI [AQ650109]); Mt May [Moogerah Peaks N.P.], 28°13′S, 152°32′E, Sep 1992, *Forster PIF11767 et al.* (BRI); Mt Barney [N.P.], south-east ridge of East Peak, 28°17′S, 152°41′E, Sep 1994, *Forster PIF15719* (BRI); Campbells Folly, 4 km SW of Tylerville, 28°18′S, 152°44′E, Sep 1992, *Forster PIF11515 & Leiper* (BRI); 1.5 km WSW of Mt Ernest, 28°19′S, 152°41′E, Aug 1999, *Halford Q3824* (BRI); Mt Ernest [Mt Barney N.P.], 28°19′S, 152°42′E, Sep 1990, *Forster PIF7389 et al.* (BRI, CANB); Mt Ernest, near Aratula, 28°19′S, 152°43′E, Sep 1989, *Leiper s.n.* (BRI [AQ458075, AQ458078]); Mt Gillies, 20 km SW of Rathdowney on Mt Lindsay Highway, Oct 1974, *Sharpe 1080* (BRI); Mt Gillies, 16 km SW of Rathdowney, 28°20′S, 152°45′E, Jul 1996, *Telford 12120 & S. Donaldson* (CANB, NE).

***Notes*:** All of the specimens listed in the '*Selected specimens examined*' under *Zieria fraseri* subsp. *fraseri* by Armstrong (2002) are referable to *Z. fraseri* subsp. *robusta*.

***Distribution and habitat*:** *Zieria fraseri* subsp. *fraseri* is found on some of the peaks of the 'Scenic Rim' (Forster 1994b) in south-eastern Qld (eg. Campbells Folly, Mt Maroon, Mt May, Mt Ernest, Mt Barney, Mt Gillies) within the Southeast Queensland bioregion and from the North Obelisk in north-eastern NSW (**Map 3**). Plants grow in clefts and crevices in rocky areas of pavement or clifflines of granophye (Mt Barney) or rhyolite (remaining peaks) (Willmott 2004), usually in heathland or shrubland though on Mt May it is found in open woodland of *Eucalyptus dura*.

***Phenology*:** Flowers have been collected in May and from July to October; fruits have been collected in September and October.

***Conservation status*:** This taxon is common and widespread on the 'Scenic Rim' and is present in National Parks such as Mt Barney (peaks of Mt Maroon, Mt Ernest, Mt Barney) and Moogerah Peaks (Mt May). A conservation status of **Least Concern** (IUCN 2001) is recommended.

15b. Zieria fraseri subsp. **robusta** (C.T.White) Duretto & P.I.Forst., **comb. et stat. nov.;** *Zieria compacta* var. *robusta* C.T.White, *Proc. Roy. Soc. Queensland* 53: 210 (1942). **Type:** Queensland. Leichhardt District: Blackdown Tableland, September 1937, *H.G.Simmons 73* (holo: BRI).

Zieria compacta var. *glabrata* C.T.White, *Proc. Roy. Soc. Queensland* 53: 209 (1942). **Type:** Queensland. Leichhardt District: Blackdown Tableland, September 1937, *H.G.Simmons 57* (holo: BRI).

***Illustrations*:** Williams (1984: 297) [as *Z. compacta* var. *glabrata*]; Pearson & Pearson (1989: 404) [as *Z. compacta* var. *glabrata*].

Shrub to 2 m tall; young branches with a sparse to dense indumentum of stellate simple and bifid hairs, or glabrous (Blackdown Tableland). Petioles 2–10 mm long, with a sparse to dense indumentum of simple and stellate hairs; terminal leaflets 15–51 × 1.5–8 mm; lateral leaflets 13–50 × 1–8 mm. Inflorescence longer than the subtending leaf, 3–20+-flowered, glabrous or with a sparse to moderately dense indumentum of simple, bifid and stellate hairs, sometimes glaucous; peduncle (4– Yandburra Station) 25–37 mm long; bracts 1–8 (–20 Blackdown Tableland) mm long; secondary peduncles 3–15 mm

long; pedicels 2–6 mm long, glabrous, stellate or simple glabrescent or with a sparse to indumentum of stellate and simple hairs. Sepals broadly ovate-triangular, 1.7–2.1 mm long and wide, abaxial surfaces glabrous or glabrescent with a few stellate hairs at base, sometimes glaucous. Petals 4–6 × 2.5–4 mm. Staminal filaments 1–1.5 mm long, glabrous (Central Qld) or with a few hairs (Blackdown Tableland); anther apiculum absent, minute to large. Cocci 4.3–4.5 × 3–3.2 mm. Seeds oblong-ovoid to ovoid, 2.1–3.1 × 1.2–1.75 mm, black, shiny, striate.

***Additional selected specimens examined*: Queensland.** LEICHHARDT DISTRICT: Near Peregrine Point, Blackdown Tableland [N.P.], 23°44′S, 149°05′E, Sep 1984, *Anderson 3814* (BRI); Blackdown Tableland, 23°46′S, 149°02′E, Jun 1977, *Telford 5727 & Ellyard* (BRI, CANB); Blackdown Tableland, 23°47′S, 149°07′E, Sep 1974, *Williams 74018* (BRI); Blackdown Tableland [N.P.], Stony Creek Vehicle parking area, 23°48′S, 149°08′E, Jul 1985, *Williams 85035 & 85036* (BRI); Blackdown Tableland, Stony Creek track, Aug 1985, *Williams 80198* (BRI); Blackdown Tableland, Aug 1973, *Trapnell 28 & Williams* (BRI); Blackdown Tableland, Sep 1971, *Henderson H962, H1201 & H1202 et al.* (BRI); Yandaburra Station, 24°42′S, 147°30′E, Sep 1984, *O'Keefe 674* (BRI); Salvator Rosa N.P., Sentinel Mt, 24°48′S, 147°08′E, Oct 1981, *Ballingall MEB442 & Cockburn* (BRI); Salvator Rosa [Carnarvon] N.P., Aug 1994, *O'Keefe 1075* (BRI); Mt Playfair – Mt Faraday area, Sep 1982, *O'Keefe s.n.* (BRI [AQ348712]); Ka Ka Mundi [Carnarvon] N.P., Bunbuncundoo Spring area, 24°52′S, 147°26′E, Sep 1993, *Purdie 4336* (CANB); Near Burnley road, S.F. 44, WSW of Theodore, 25°02′S, 149°46′E, Jan 2003, *Bean 19861* (BRI).

***Notes*:** All of the specimens listed in the '*Selected specimens examined*' under *Zieria fraseri* subsp. *fraseri* by Armstrong (2002) are referable to *Z. fraseri* subsp. *robusta*.

Zieria fraseri subsp. *robusta*, especially populations on the Blackdown Tableland, can have noticeably longer leaflets and much larger flowers than *Z. fraseri* subsp. *fraseri* though the variation seen in the subspecies overlaps. As noted by Armstrong (2002), individuals with both glabrous and pubescent stems may occur in the same population on the Blackdown Tableland.

The collections from Yandaburra Station (*O'Keefe 674*) and from near Theodore (*Bean 19861*) and Carnarvon Gorge (*Parris 9110*) have inflorescences that are shorter than the subtending leaves. The specimen from near Theodore (*Bean 19861*) is the only collection of this taxon from outside the Blackdown Tableland and the Salvator Rosa/Carnarvon Gorge area. It was collected in midsummer and this may be why the inflorescence appears to be shorter than the leaves, that is, well outside the normal flowering time for the taxon (see below). All three collections do have sepals and pedicels that are glabrous and glaucous. These populations require further investigation.

***Distribution and habitat*:** *Zieria fraseri* subsp. *robusta* is endemic to Qld within the Brigalow Belt bioregion and is found mainly in two areas, the Blackdown Tableland and Salvator Rosa though isolated collections have been made at Carnarvon Gorge (Wards Canyon) and from near Theodore (**Map 3**). Armstrong (2002) mapped these areas, but did not mention the populations at Salvator Rosa in his discussion on the distribution of *Z. fraseri*.

At Blackdown Tableland and Salvator Rosa the subspecies is found in open *Eucalyptus* or *Eucalyptus/Allocasuarina* forest or shrubland/heath on sand or sandstone; at Carnarvon Gorge (Wards Canyon) at the foot of vertical cliffs, amongst boulders in a woodland of *E. propinqua* and *Livistona fulva*; near Theodore it was collected on the edge of a sandstone escarpment in a low woodland of *Corymbia trachyphloia, Eucalyptus tenuipes, Lysicarpus angustifolius* and *Petalostigma pachyphyllum*.

***Phenology*:** Flowers have been collected in August and September, and fruits in October and rarely in January.

***Conservation status*:** This subspecies is widespread and locally common and is primarily found in National Parks. A conservation status of **Least Concern** (IUCN 2001) is recommended.

***Etymology*:** We have used White's varietal epithet *robusta* as it suitably describes the more robust habit of this subspecies.

16. Zieria furfuracea R.Br. ex Benth., *Fl. Austral.* 1: 306 (1863). **Type:** New South Wales. North Coast: Hastings River, *Beckler s.n.* (lecto [designated by Armstrong (2002: 358)]: K [Herbarium Hookerianum]; isolecto: MEL 62061, 62062, 62063).

***Notes*:** As circumscribed by Armstrong (2002), *Zieria furfuracea* comprises three subspecies distributed from north-eastern NSW to south-eastern Qld, with the nominate subspecies not occurring in Qld.

In his key to the subspecies of *Zieria furfuracea*, Armstrong (2002) outlines a range of character states (especially bud aestivation) that may justify recognition of these taxa at specific rank. The three subspecies that he recognises are all quite disjunct in their occurrence, with few obvious regions of intergradation. Despite this, these different subspecies are all superficially similar and would appear to form a monophyletic group.

Key to the subspecies of *Z. furfuracea* found in Queensland

1. Leaflet lamina margin entire or somewhat sinuate with poorly developed marginal glands; petals valvate in bud . . . . . .subsp. **euthadenia**
   Leaflet lamina margin crenate with well developed marginal glands; petals imbricate in bud . . . . . .subsp. **gymnocarpa**

16a. Zieria furfuracea subsp. **euthadenia** J.A.Armstr., *Austral. Syst. Bot.* 15: 362 (2002). **Type:** Queensland. Moreton District: Kin Kin, January 1917, *C.T.White s.n.* (holo: BRI [AQ318532]).

Zieria furfuracea subsp. (Kin Kin V.K.Moriarty 134); Forster (2002: 181).

***Illustrations*:** Hauser & Blok (1998: 368) [as *Z. furfuracea*]; Armstrong (2002: 363).

***Additional specimens examined*: Queensland.** Wide Bay District: Mt Woocoo, S.F. 57, St Mary, 25°40′S, 152°23′E, Jun 1993, *Forster PIF13375 & Machin* (BRI, CANB, MEL); *loc. cit.*, Apr 1996, *Forster PIF19115 & Leiper* (AD, BRI, MEL); *loc. cit.*, Aug 1996, *Forster PIF19503 & Leiper* (AD, BRI, CANB, MEL, NSW, NY); *loc. cit.*, Mar 2000, *Forster PIF25347 & Booth* (AD, BRI, HO, MEL, NE, NSW); Parsons road, west of Mt Coondoo, via Kin Kin, 26°11'S, 152°55'E, Sep 1993, *Bean 6488* (BRI, MEL). Moreton District: Como S.F., S.F. 1004, Toolara, just off Kin Kin – Pomona road, 26°12′S, 152°54′E, Feb 1994, *Grimshaw G487 & Spearritt* (BRI); Beenham Range, about 6 km N of Kin Kin, 26°13′S, 152°51′E, May 1988, *Sharpe 4809* (BRI); W slopes of Mt Tinbeerwah, 6 km W of Tewantin, 26°23′S, 152°58′E, Dec 1990, *Bean 2822* (BRI); Yandina Creek, about 12 km NE of Yandina, 26°30′S, 153°00′E, Apr 1991, *Sharpe 5012 & Thomas* (BRI, MEL); Belli L.A., Mapleton S.F., SW of Eumundi, 26°31′S, 152°51′E, Apr 1998, *Bean 13192* (BRI, MEL); S.F. 689, N of the Valdora to North Arm road, Alandale road to the East, 26°31′S, 152°59′E, Aug 1999, *Thomas 408M* (BRI); Scrubby Pocket road, Mapleton S.F., south of Belli, 26°32′S, 152°51′E, Mar 1993, *Bean 5901* (BRI; NSW n.v.); Rocky Creek, S.F. 249, SE of Yandina, 26°35′S, 152°59′E, Apr 1990, *Bean 1501* (BRI); Dularcha N.P., N of Landsborough, 26°47′S, 152°58′E, Jan 1990, *Bean 1319* (BRI).

***Notes*:** This taxon was recognised by Armstrong (2002) as a subspecies of *Zieria furfuracea*, although there appears to be some confusion in that account as to where he considered *Z. furfuracea* subsp. *furfuracea* to occur. In the specimens cited and mapped in his Fig. 54, Armstrong clearly indicates that *Z. furfuracea* subsp. *furfuracea* is endemic to north-eastern NSW, as also stated by Armstrong and Harden (2002), yet in his discussion on distribution he states that it is "distributed from the Wide Bay District of south-eastern Queensland south to the Northern Coast and Tablelands and the Central Coast of NSW, north from the Wyong district. At Cedar Creek, in south-eastern Queensland, the taxon forms shrubs up to 1 m high". Yet he has clearly annotated (at BRI) and cites specimens from Cedar Creek under his *Z. furfuracea* subsp. *euthadenia*.

***Distribution and habitat*:** *Zieria furfuracea* subsp. *euthadenia* is endemic to Qld and has been recorded from a number of populations centred in the Kin Kin area, as well as a more northerly disjunct occurrence at Mt Woocoo within the Southeast Queensland bioregion (**Map 9**). The subspecies has been collected in open eucalypt forest or shrubland, in association with a number of different canopy species, including *Eucalyptus grandis*, *E. helidonica*, *E. propinqua*, *Syncarpia glomulifera*, *Corymbia citriodora*,

C. intermedia and *Leptospermum* species. At Mt Woocoo the species occurs on sandstone.

***Phenology*:** Flowers have been collected in January, March to June, August, September and December, and fruits in April, May, August, September and December.

***Conservation status*:** Armstrong (2002: 363) listed this taxon as 2K and stated that "the conservation status cannot be reliably determined". Recent collections from its area of distribution indicate that this subspecies is reasonably common with populations in Dularcha and Glasshouse Mountains N.P.s, as well as a number of state forests. A conservation status of **Least Concern** (IUCN 2001) is recommended.

16b. Zieria furfuracea subsp. **gymnocarpa** J.A.Armstr., *Austral. Syst. Bot.* 15: 363 (2002). **Type:** Queensland. MORETON DISTRICT: Belmont, 10 September 1887, *J.H.Simmonds s.n.* (holo: BRI [AQ318534]).

Zieria furfuracea subsp. (Belmont Scrub Anon. AQ152898); Forster (2002: 181)

***Illustrations*:** Armstrong (2002: 364); Logan River Branch SGAP (QLD Region) Inc. (2005: 175).

***Additional specimens examined*: Queensland.** MORETON DISTRICT: Belmont, RP10826, entrance to Greendale way near intersection with Weekes road, Mar 1997, *Leiper s.n.* (BRI [AQ654847], MEL, NSW); Belmont, Greendale way, Aug 2002, *Leiper s.n.* (BRI [AQ732223]); Belmont Hills Bushland complex, off Greendale way, Sep 2002, *Leiper s.n.* (BRI [AQ764008]); Belmont, 126 Scrub road, Mar 1997, *Leiper s.n.* (BRI [AQ654846], MEL); Brisbane City Council land, Belmont, Apr 1997, *Leiper s.n.* (BRI [AQ653837], MEL); Mt Petrie road, Belmont, Apr 1997, *Leiper s.n.* (BRI [AQ653835], NSW); Belmont Hills Bushland complex, off Greendale way, Sep 2002, *Leiper s.n.* (BRI [AQ764009]); Belmont Hills Bushland Reserve, Sep 2002, *Leiper s.n.* (BRI [AQ764012, AQ764014, AQ764015]); Belmont Hills Bushland Reserve, Spider Gully, Sep 2002, *Leiper s.n.* (BRI [AQ764011]); regrowth area adjacent to Gateway motorway at Belmont, Oct 2002, *Leiper s.n.* (BRI [AQ770316]); Gateway Bridge motorway near Belmont Hill, Feb 2000, *Leiper s.n.* (BRI [AQ667718]); South facing gully below summit of Mt Petrie, Nov 2002, *Leiper s.n.* (BRI [AQ770760]); BCC Reserve, Mt Petrie road, Belmont, Oct 2002, *Leiper s.n.* (BRI [AQ764010]); bank of drain between Gateway motorway & Mt Petrie road, Oct 2002, *Leiper s.n.* (BRI [AQ770317, AQ770314]).

***Notes*:** This subspecies is perhaps most easily recognised by the weakly crenate leaf margin.

***Distribution and habitat*:** *Zieria furfuracea* subsp. *gymnocarpa* is endemic to Qld and restricted to a small area in the Brisbane suburb of Belmont within the Southeast Queensland bioregion (**Map 9**). It occurs as an understorey shrub in an open forest that includes *Acacia disparrima, Allocasuarina littoralis, Eucalyptus carnea, E. crebra, E. propinqua, E. microcorys, Corymbia intermedia* and *Lophostemon confertus.* Plants have also been collected in regrowth vegetation dominated by *Megathyrsus maximus* var. *pubiglumis* (guinea grass) and *Acacia disparrima.*

***Phenology*:** Flowers have been collected from February to April and August to November, and fruits from February to April, and in September and October.

***Conservation status*:** This taxon was incorrectly stated by Armstrong (2002) to be extinct, although it had been rediscovered in 1997 by Glenn Leiper. It is currently listed as **Endangered** in Qld (*NCA* 1994). A detailed survey of the known populations of this taxon by Leiper (2002) indicates that there are approximately 8900 individuals in seven populations. Direct threats to the populations of this subspecies are road maintenance on the Gateway motorway, destruction of remaining bushland remnants, weed invasion and changed fire regimes resulting from weeds and pyromaniacs.

17. Zieria graniticola J.A.Armstr. ex Duretto & P.I.Forst., **species nova** a *Z. aspalathoide* A.Cunn. ex Benth. differt caulibus foliisque clare glandulari-verrucosis (adversum indistincte glandulari-verrucosa), sepalorum indumento stellato (in illa plerumque piloso) et petiolo majore (1–3 mm adversum 0–1 mm longitudine) differt. **Typus:** Queensland. DARLING DOWNS DISTRICT: Mt Janet road, Passchendale State Forest, NW of Stanthorpe, 28°33′S, 151°48′E, 4 October 1997, *A.R.Bean 12477* (holo: BRI; iso: MEL 2095863).

Zieria sp. (Amiens L.Pedley 1518); Forster (1997b: 188; 2007: 183).

Shrub to 1 m tall forming a densely compact bush. Stems erect, wiry; branches weakly glandular verrucose, with a dense indumentum of mainly simple and bifid (though also with

trifid and stellate) hairs between the very faint decurrent leaf bases, otherwise glabrous or pilose (*Halford Q2330*). Leaves palmately trifoliolate; petioles 1–3 mm long, weakly glandular verrucose, adaxial surfaces pilose, abaxial surfaces glabrescent or pilose (*Halford Q2330*); terminal leaflets narrow elliptic to narrow oblanceolate, 6–18 × 1.5–4 mm, tips acute, margins recurved to revolute, slightly glandular dentate, midrib raised abaxially and weakly to strongly glandular verrucose, both surfaces glabrescent with hairs on midvein and at tips or sparsely pilose (*Halford Q2330*), with tufts of simple hairs at join of leaflets and petioles; lateral leaflets similar to terminal leaflets though usually slightly smaller. Inflorescence axillary, shorter or longer than the subtending leaves, 1–3 (–9 Amiens)-flowered, weakly glandular verrucose, pilose with hairs concentrated between decurrent bract bases; peduncle 0.5–2.5 (–13 Amiens) mm long; bracts narrow-elliptic to narrow-lanceolate, persistent, 1–5 mm long; pedicels 1.5–5 mm long, with a moderately dense stellate indumentum. Sepals ovate-deltate, 1–1.5 × 0.9–1 mm, valvate in bud, glandular but not glandular verrucose, tips acute to slightly acuminate, adaxial surfaces with a sparse to moderately dense simple and stellate indumentum, abaxial surfaces with a sparse to moderately dense stellate indumentum. Petals elliptic, (2.5– *Halford Q2330*) 3.5–4.5 × 2.2–2.5 mm, pale pink, valvate or slightly imbricate in bud, not obviously glandular, both surfaces with a moderately dense to dense indumentum of mainly stellate hairs. Staminal filaments *c.* 1.2 mm long, with scattered stellate and simple hairs distally, very slightly glandular verrucose at apex; anthers *c.* 0.6 mm long, apiculum minute. Gynoecium glabrous or sparsely pilose (*Halford Q2330*). Cocci [mature not observed] 4–4.5 mm × *c.* 2.5 mm, slightly glandular verrucose, glabrous or sparsely pilose dorsally (*Halford Q2330*), base of style sometimes persistent forming a minute apical apiculum. Seeds not observed. **Fig. 9.**

***Additional specimens examined*: Queensland.** Darling Downs District: Messines via Cottonvale, Sep 1930, *Greener s.n.* (BRI [AQ 531208]); Bapaume via Cottonvale, Oct 1930, *Horn 15* (BRI); Amiens, 28°35'S, 151°48'E, Oct 1966, *Harslett s.n.* (CANB 559713); 'Mountain View', Amiens, Oct 1983, *Harslett s.n.* (BRI [AQ 393825], CANB [CBG8905597]); *loc. cit.*, Oct 1966, *Frazier s.n.* (NSW 98643); Amiens via Stanthorpe, 28°35'S, 151°48'E, Aug 1983, *Harslett s.n.* (BRI [AQ 349637 – 2 sheets]); Amiens WNW of Stanthorpe, Oct 1963, *Harslett sub Pedley 1518* (BRI, CANB); *c.* 1 mile [1.7 km] W of Jollys Falls, 5 miles [8.3 km] N of Stanthorpe, Oct 1963, *Pedley 1534* (BRI, HO); 15.7 km SW of Stanthorpe, Portion 87, Stalling lane, 28°44'S, 151°48'E, Nov 1994, *Halford Q2330* (BRI, MEL); 6.5 km W of Glen Aplin, Portion 87, Stalling lane, Nov 1994, *Halford Q2346* (BRI).

***Notes*:** *Zieria graniticola* was a manuscript name used by J.A.Armstrong on many herbarium specimens and not subsequently published (see Armstrong 2002). Under *Z. aspalathoides*, in his published account (Armstrong 2002), he refers to a form from south-eastern Qld (Amiens, Girraween N.P., Wyberba, Mt Norman) and the Northern Tablelands of NSW (Silent Grove, Tenterfield) with "attenuate calyx lobes, short compact inflorescences generally shorter than the subtending leaves and younger branches with very noticeable allotrichous pubescence" which appears to be a local variant of *Z. aspalathoides* (see also discussion under of *Z. aspalathoides* subsp. *aspalathoides*). Under *Z. laevigata* he discusses a form from near Wallangarra and Wyberba that he suggested was a stabilised hybrid between *Z. laevigata* and *Z. aspalathoides*. These plants are similar to *Z. graniticola* in leaf shape but are tomentose on the abaxial surface of the leaves as is *Z. laevigata* (see also discussion under that species) and warrant further investigation.

Collections of *Zieria graniticola* from the Cottonvale/Amiens area (north of Stanthorpe) are fairly uniform in general appearance. The specimens collected south of Stanthorpe (*Halford Q2330, Q2346*) differ from these by being sparsely pilose all over the stems (versus hairs confined to area between faintly decurrent leaf bases) and leaves (versus glabrescent), having smaller leaves and petals (2.5–3.2 mm long versus 3.5–4.5 mm long) and sparsely pilose cocci (versus glabrous). *Halford Q2330* and *Q2346* look similar to *Z.* sp. 'Cathedral Rock' (Williams 95303) as described in Armstrong and Harden (2002) which is found in the Cathedral Rock N.P. (NSW) (*Williams 95303*, NSW 433121) and

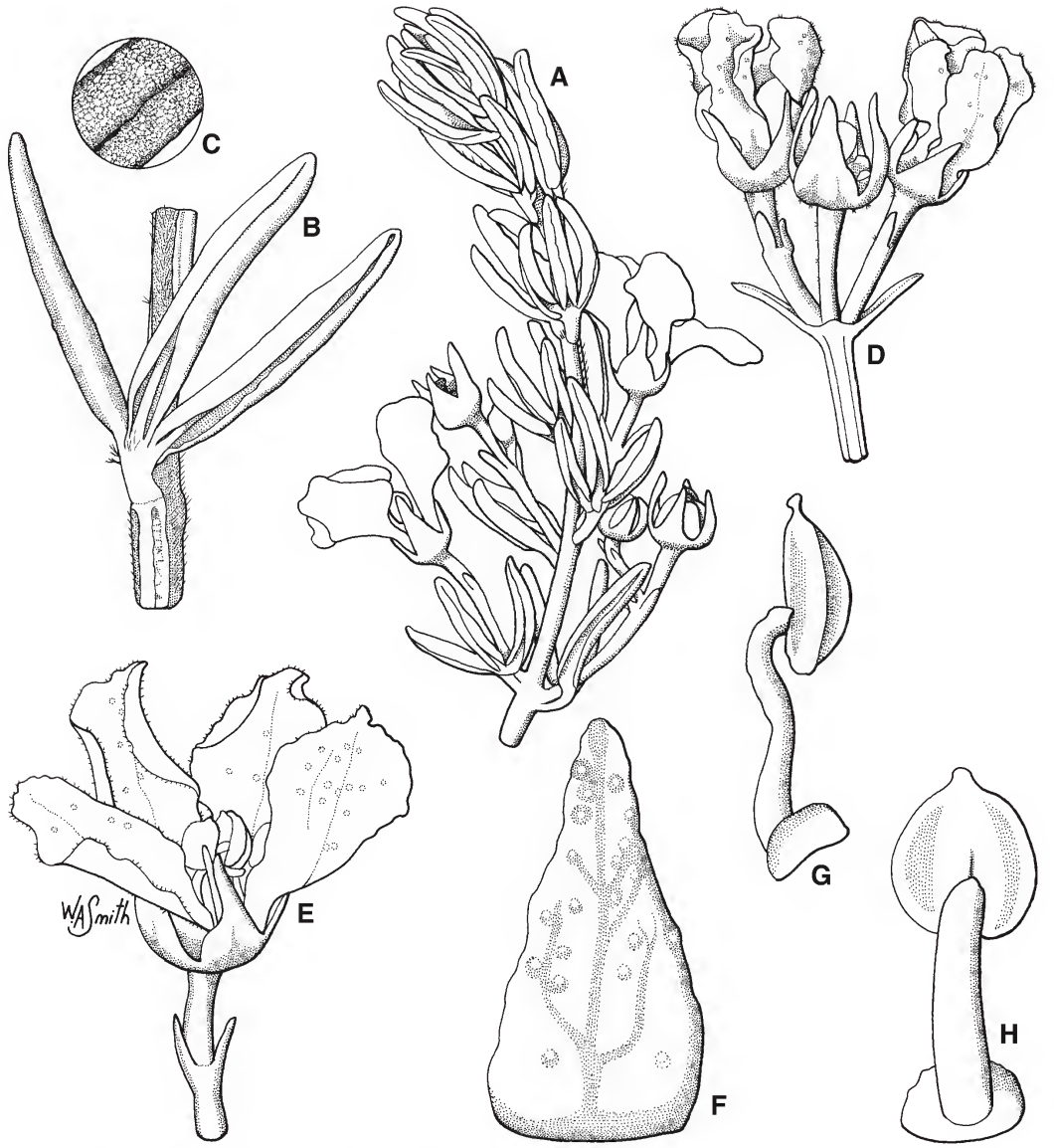

Fig. 9. *Zieria graniticola*. A. branch with several flowering inflorescences × 4. B. stem node with abaxial view of leaf × 8. C. detail of indumentum on abaxial surface of leaflet × 20. D. inflorescence with flowers and immature fruit × 6. E. flower × 6. F. abaxial view of sepal × 20. G–H. views of stamens × 20. A–E, G–H from *Harslett s.n.* (BRI [AQ393826]); F from *Halford Q2346* (BRI). Del. W. Smith.

Howell area (NSW) (*Williams s.n.* NSW 651474, *Williams s.n.* NSW 651470). *Z.* sp. 'Cathedral Rock' (Williams 95303) has leaflets that are noticeably more glandular tuberculate and in itself is very poorly known.

Zieria graniticola appears to be sympatric with *Z. aspalathoides* at Amiens and many of J. Harslett's collections from there are mixed collections, with different species having the same collection information at different herbaria. Herbarium sheet numbers are cited for these collections.

***Distribution and habitat*:** *Zieria graniticola* is endemic to Qld and confined to two disjunct areas north and south of Stanthorpe within the New England Tableland bioregion (**Map 9**). It

is found growing in sandy soil over granite. In Passchendale S.F. it is found in an open forest of *Eucalyptus andrewsii* and *E. banksii* with a shrubby understorey. Some collections have also been from rocky outcrops.

***Phenology*:** Flowers have been collected from August to November, and fruit in October and November.

***Conservation status*:** Collector's notes indicate that this species is rare in the Passchendale S.F. but is considered common at Stallen Lane (south-west of Stanthorpe). *Zieria graniticola* has a very restricted distribution and does not appear to be found in any conservation reserve. It can be assessed as **Endangered** on the basis of criteria B2a,b(i-v) (IUCN 2001). Surveys are required to ascertain the size and extent of the known populations and the area of occupancy.

***Etymology*:** The name refers to the granite substrate that this species grows on.

18. Zieria hydroscopica Duretto & P.I.Forst. **species nova** a *Z. smithii* Jacks. foliolis in pagina adaxiali pilosis (adversum foliola glabra vel glabrescentia vel pilis dispersis stellatis), et in ramis pilis stellatis radiis longioribus (radii longitudine usque ad 0.5 mm adversum ad *c.* 0.1 mm); et a *Z. boolbunda* Duretto & P.I.Forst. foliis basi non vel tantum leviter decurrentibus (adversum folia manifeste decurrentia) differt. **Typus:** Queensland. Burnett District: Rocky Gorge Waterhole, Coominglah S.F., west of Monto, 24°53′S, 150°56′E, 16 September 1995, *A.R.Bean 8959 & P.Robbins* (holo: BRI; iso: MEL 2095862).

Zieria sp. (Coominglah A.R.Bean 8959); Forster (2002: 181; 2007: 183)

Shrub to 50 cm tall, forming an open compact bush. Stems erect, wiry; young branches without or with slightly decurrent leaf bases, slightly glandular verrucose, with a sparse indumentum of stellate hairs that is denser between the decurrent leaf bases, becoming glabrescent with age. Leaves palmately trifoliolate; petioles 8–11 mm long, slightly glandular verrucose, with a sparse indumentum of stellate and simple hairs; terminal leaflets narrow elliptic to narrow lanceolate, 20–33 × 4–6 mm, tips obtuse to acute, margins flat to recurved or slightly revolute [though possibly only on drying], midribs strongly raised abaxially, very slightly glandular verrucose, secondary veins raised abaxially, adaxial surfaces with a sparse, pilose indumentum of mainly simple and bifid hairs, abaxial surfaces with a sparse indumentum of simple, bifid and stellate hairs, lateral leaflets similar to terminal leaflets though they can be shorter or longer. Inflorescence axillary, shorter than the subtending leaf, 8–25+-flowered, not or slightly glandular verrucose, with a sparse simple and stellate indumentum; peduncle 2–8 mm long; bracts scale or leaf like, lower ones mostly deciduous though upper ones persistent, 1–4.5 mm long; pedicels 1–3.5 mm long, not or slightly glandular verrucose, with a moderately dense stellate tomentum. Sepals deltate, *c.* 1 mm long and wide, valvate or slightly imbricate in bud, slightly glandular verrucose, tips acute, adaxial surfaces with scattered appressed simple hairs, abaxial surfaces with a moderately dense stellate indumentum. Petals narrow-elliptic, 2.1–2.5 × 1.2–1.5 mm, white, imbricate in bud, not obviously glandular, both surfaces densely stellate-tomentose. Staminal filaments *c.* 1 mm long, with minute, simple hairs along length, weakly glandular verrucose near tip; anthers *c.* 0.5 mm long, apiculum absent. Ovary glabrous; style glabrous or simple glabrescent. Cocci [only very immature seen] with scattered stellate hairs. Seeds not observed. **Fig. 10.**

***Additional specimen examined*:** Burnett District: Coominglah S.F., Boolgalgopal Creek, The Rock Hole, 24°53′S 150°57′E, Nov 1993, *Telford 11900* (BRI, CANB, HO, NSW *n.v.*).

***Notes*:** *Zieria hydroscopica* is similar to *Z. smithii* but differs in having leaflets that are pilose on the adaxial surface (versus glabrous, glabrescent or with scattered stellate hairs), and having stellate hairs on the branches with longer rays (0.5 mm long versus to *c.* 0.1 mm long). It differs from *Z. boolbunda* in having leaf bases that are not or only slightly decurrent versus obviously decurrent.

***Distribution and habitat*:** The taxon is known only from Coominglah S.F. near Monto in

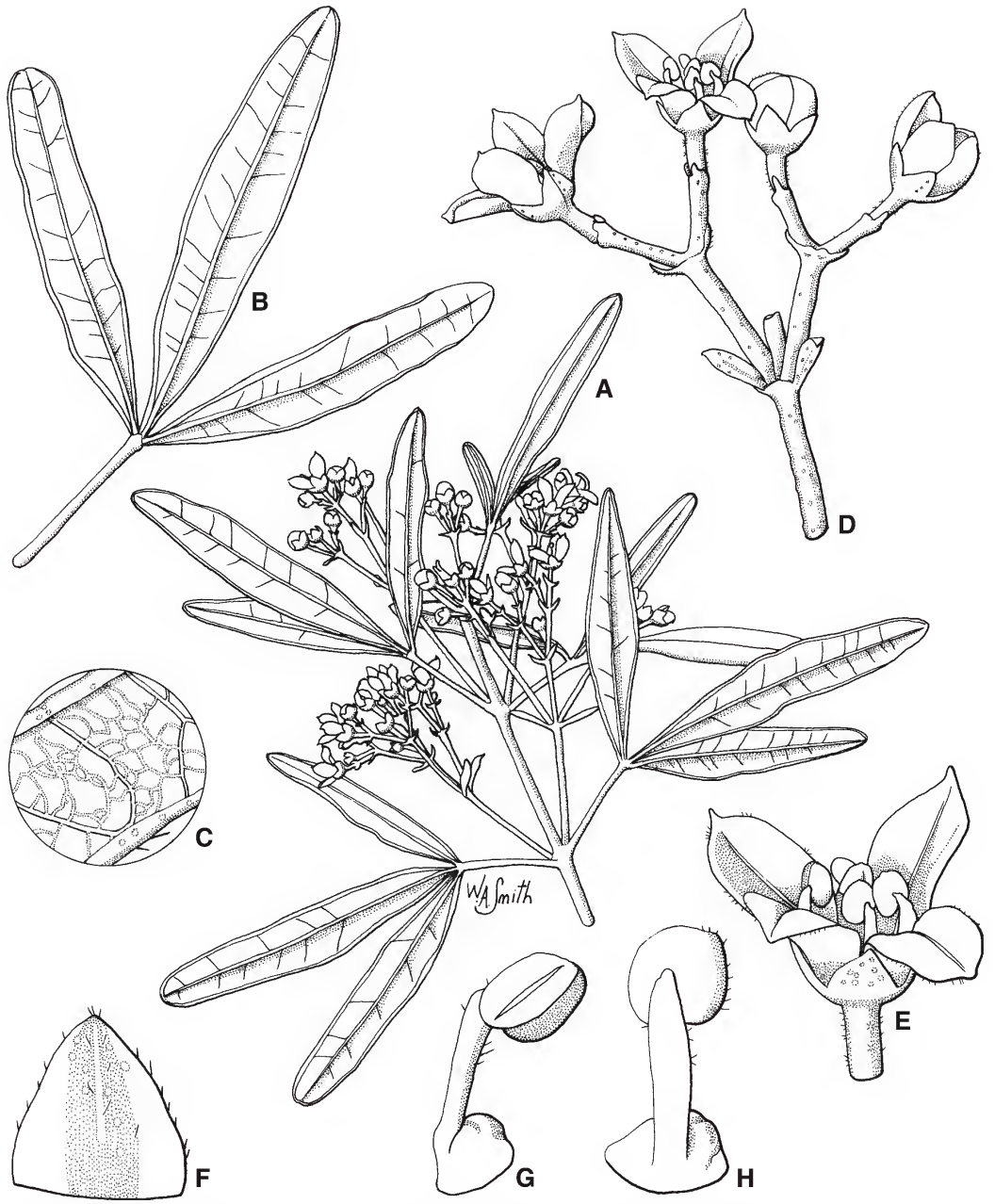

Fig. 10. *Zieria hydroscopica*. A. branch with several flowering inflorescences × 1.5. B. abaxial view of leaf × 2. C. detail of indumentum on abaxial surface of leaflet × 8. D. inflorescence with bud and flowers × 4. E. flower × 8. F. abaxial view of sepal × 20. G–H. views of stamens × 20. All from *Bean 8959* (BRI). Del. W. Smith.

the Brigalow Belt bioregion (**Map 12**). The specimen from Rocky Gorge (*Bean 8959 & P.Robbins*) was collected from a rocky creekbed with *Corymbia trachyphloia* and *Lophostemon suaveolens*, while the specimen from Boolgalgopal Creek (*Telford 11900*) was collected from an open forest of *Eucalyptus acmenoides*, *Angophora leiocarpa*, *Allocasuarina littoralis* and *Dodonaea triangularis*.

***Phenology*:** Flowers have been collected in September.

***Conservation status*:** Both collectors noted that few plants were seen. On the basis of known data, this species can be assessed as **Endangered** on the criteria of B2a, D (IUCN 2001). The Coominglah Range is notable for the presence of the endemic *Pomaderris coomingalensis* N.G.Walsh & Coates and the near endemics (a significant number of known populations) *Boronia palasepala* Duretto, *Grevillea hockingsii* Molyneux & Olde and *Solanum lythrocarpum* A.R.Bean.

***Eymology*:** The specific epithet is derived from the Greek *hydro-* (water) and *scopic* (watcher) and alludes to the populations of this plant occurring near water holes.

19. Zieria inexpectata Duretto & P.I.Forst. **species nova** a *Z. aspalathoide* A.Cunn. ex Benth. caulibus foliisque glandulari-verrucosis (adversum indistincte glandulari-verrucosa) et petiolis longioribus (1–1.5 adversum 0–1 mm longitudine) differt. **Typus:** Queensland. Burnett District: 'Bronte', 9 km SW of Gayndah, 25°43′S, 151°30′E, 14 September 1999, *P.I.Forster PIF24851, M.F.Duretto & P.Grimshaw* (holo: BRI; iso: AD, K, MEL 306443, NSW).

Shrub to 50 cm tall forming a densely compact bush. Stems erect, wiry; branches without decurrent leaf bases, weakly glandular verrucose, pilose with simple, bifid and few trifid hairs. Leaves palmately trifoliolate (though first pair of leaves on secondary shoots simple), weakly glandular verrucose; petioles 1–1.5 mm long, glabrescent to sparsely hairy; terminal leaflets narrow elliptic to narrow oblanceolate, 4–6.5 (–9) × 0.7–2.5 mm, tips obtuse, margins recurved to revolute, glandular dentate, midribs raised abaxially, adaxial surfaces glabrescent to sparsely pilose, abaxial surfaces glabrescent with few simple hairs, especially along midribs, as well as tufts of simple hairs at join of leaflets and petioles; lateral leaflets similar to terminal leaflets. Inflorescence axillary, longer than the subtending leaf, 1–12-flowered, weakly glandular verrucose, pilose with hairs concentrated between decurrent bract bases; peduncle 4–11 mm long; bracts narrow-elliptic to narrow-lanceolate, persistent, 1–2 mm long; secondary peduncles 3–4 mm long; pedicels 2–3 mm long. Sepals ovate-deltate, 1–2 × 0.7–1.5 mm, valvate in bud, glandular but not glandular verrucose, tips acute, adaxial surfaces puberulous, abaxial surfaces with scattered stellate hairs concentrated at base. Petals elliptic, 2–3 × 1.5–2.5 mm, white, valvate in bud, not obviously glandular, adaxial surfaces with a sparse indumentum of simple and stellate hairs, abaxial surfaces with a dense indumentum of simple and stellate hairs. Staminal filaments 1–1.2 mm long, with scattered stellate and simple hairs, slightly glandular verrucose at apex; anthers *c.* 0.5 mm long, apiculum minute. Gynoecium glabrous. Cocci *c.* 3.5 × 2 mm, slightly glandular verrucose, glabrous, base of style sometimes persistent forming a minute apical apiculum. Seeds not observed. **Fig. 11.**

***Additional specimens examined*: Queensland.** Burnett District: Aranbanga Creek catchment area, 'Bronte', Sep 1999, *Duretto 1318, Forster & Grimshaw* (BRI, MEL); 'Bronte', 9 km WSW of Gayndah, Jun 2000, *Forster PIF25857* (BRI, MEL); S.F. 146, SE of Proston, 26°14′S, 151°38′E, Mar 1996, *Bean 11818* (BRI, MEL, NSW); Compartment 21, S.F. 12, near Wondai, 26°21′S, 151°58′E, Sep 1996, *Bean 10822* (BRI, MEL, NSW).

***Notes*:** *Zieria inexpectata* is superficially similar to the widespread *Z. aspalathoides*, but can be distinguished from that species in the stems and leaves being glandular verrucose (versus not obviously glandular verrucose) and the leaf petioles being greater than 1 mm long (versus subsessile to 1 mm long). Material from southern parts of the species range, eg. S.F. 12 (*Bean 10822*) and from near Proston (*Bean 11818*), have smaller floral parts than material from the type locality at 'Bronte'. There are too few collections to determine if this variation warrants taxonomic recognition.

***Distribution and habitat*:** *Zieria inexpectata* is endemic to Qld within the Brigalow Belt and Southeast Queensland bioregions (**Map 9**) where it is known from a few localities in the central Burnett District: 'Bronte' south west of Gayndah, S.F. 146 near Proston, and S.F. 12 near Wondai. At 'Bronte', *Z. inexpectata* occurs in woodland dominated by *Corymbia trachyphloia*, *C. citriodora*, *Lysicarpus angustifolius* and *Acacia sparsiflora* on a

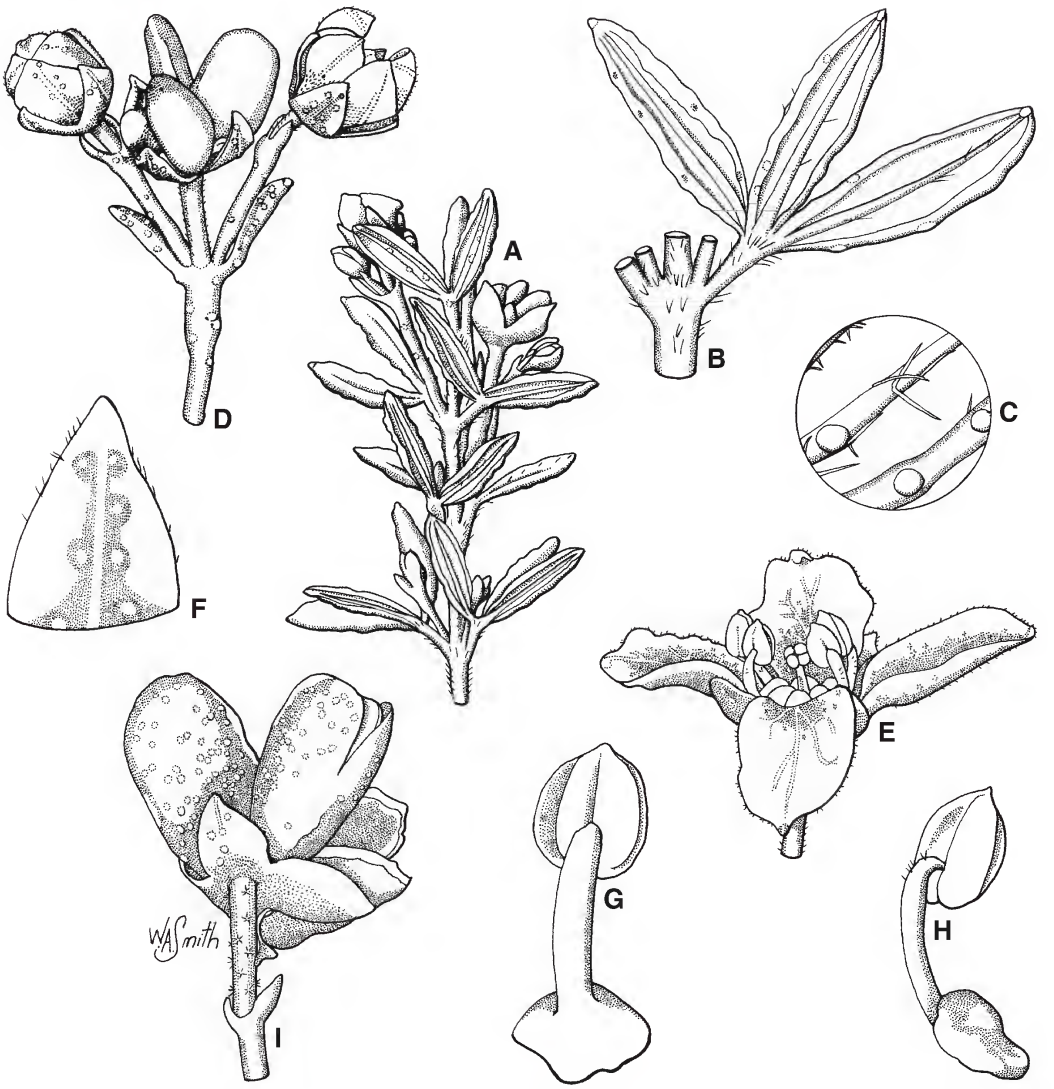

Fig. 11. ***Zieria inexpectata.*** A. branch with several flowering inflorescences × 4. B. stem node with abaxial view of leaf × 8. C. detail of indumentum on abaxial surface of leaflet × 20. D. inflorescence with bud, flower and immature fruit × 6. E. flower × 8. F. abaxial view of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. All from *Forster PIF24851* (BRI). Del. W. Smith.

duricrust jumpup. Other associated species include *Hovea planifolia*, *Boronia grimshawii*, *Podolobium ilicifolium*, *Logania albiflora*, *Alphitonia excelsa* and *Entolasia stricta*. At S.F. 12 and S.F. 146 the species is found in an open forest of *C. citriodora* and *Eucalyptus* spp., or *C. watsoniana* and *Lysicarpus angustifolius*. Invariably *Z. inexpectata* is found growing in sandy soil.

***Phenology*:** Flowers have been collected from March to November, and fruit from June to November.

***Conservation status*:** Several hundred plants are present at the type locality. Here, the species co-occurs with two locally endemic species: *Boronia grimshawii* Duretto, and an undescribed species of *Acacia*. The type locality is on private land that is bisected by a gazetted road. At S.F. 12 (near Wondai)

the species is not common while at S.F. 146 (near Proston) the species was reported to be common (collector's notes). An appropriate conservation coding is **Endangered** under the criteria of B2a,b(iii),(v), C2a (IUCN 2001). The total area of known occupancy is less than 20 ha and perceived threats are grazing by stock, fire and deliberate destruction of plants.

***Etymology*:** The specific epithet alludes to the collection of this undescribed *inex(s)pectatus* (unexpected), species while investigating the population of the newly discovered, and then undescribed, *Boronia grimshawii* at the type locality.

20. Zieria insularis Duretto & P.I.Forst., **species nova** a *Z. smithii* Jacks. habitu debili, foliolis parvis praeditis indumento praecipue pilorum simplicium bifidorumque (in illa stellatorum) in pagina abaxiali differt. **Typus:** Queensland. Cook District: State Forest 144, Mt Windsor Tableland, 16°15′S, 145°02′E, 11 July 1995, *P.I.Forster PIF17246 & S.J.Figg* (holo: BRI; iso: AD, DNA, K, MEL, NSW, QRS).

Zieria smithii subsp. (SF144 B.Gray 428); Forster (2002: 181).

Shrub to 2 m tall, forming an open straggly bush. Stems erect to decumbent, wiry to spindly; branches with faintly decurrent leaf bases, not glandular verrucose, pilose with mainly simple and bifid hairs, hairs denser between leaf decurrencies. Leaves palmately trifoliolate; petioles 2–4 mm long, with a sparse indumentum of simple and bifid hairs; terminal leaflets narrow-elliptic, elliptic, or obovate, 8–21 × 2–6 mm, laminae weakly pellucid gland dotted, not glandular verrucose, tips acute to obtuse, margins slightly crenulate, ± flat, midribs raised abaxially, secondary veins obscure, adaxial surfaces glabrescent with few simple hairs along midrib or with a sparse indumentum of simple and bifid hairs, abaxial surfaces with a sparse indumentum of simple and bifid hairs though a few stellate stellate hairs sometimes also present; lateral leaflets similar to terminal leaflets though usually slightly smaller. Inflorescence axillary, 1–several per axil, some at least longer than the subtending leaf, 1–several-flowered, not obviously glandular, sparsely pilose with simple and bifid hairs; peduncle 5–20 mm long; bracts linear, persistent, 0.4–2 mm long; secondary peduncles 2–5 mm long; pedicels 1–2 mm long. Sepals deltate, 1–1.1 mm long and wide, valvate in bud, not obviously glandular, tips acute, adaxial surfaces sparsely pilose, abaxial surfaces with a sparse indumentum of stellate hairs. Petals lanceolate-elliptic, *c.* 3 × 1.5 mm, white, valvate in bud, not obviously glandular, both surfaces with a sparse to dense stellate indumentum. Staminal filaments 1–1.2 mm long, glabrous or with the occasional hair, eglandular; anthers 0.6–0.7 mm long, apiculum absent or small and recurved. Gynoecium glabrous. Cocci 3–4 × 1.5–2 mm, not glandular verrucose, glabrous or with few hairs, base of style sometimes persistent forming a minute apical apiculum. Mature seeds not observed. **Fig. 12.**

***Additional collections examined*: Queensland.** Cook District: Mt Windsor, Granite Dome, Jun 1982, *Hind 3168* (NSW); Mt Windsor forestry camp, on Spencers Creek, 16°15′S, 145°07′E, Aug 1998, *Hind 5684 & D'Aubert* (HO, NSW); S.F.R. 144, 16°16′S, 145°05′E, Mar 1977, *Gray 428* (BRI, CANB); Daintree N.P., Little Daintree River, 16°21′S, 145°10′E, May 1998, *Forster PIF22796 et al.* (AD, BRI, MEL, QRS); Daintree N.P., northwest of Black Mountain, 16°22′S, 145°11′E, May 1998, *Forster PIF22873 et al.* (AD, BRI, K, MEL, NSW).

***Notes*:** *Zieria insularis* appears to be related to *Z. smithii* but has a weaker habit, smaller leaves and an indumentum of mainly simple and bifid hairs (versus stellate) on the abaxial surface of the leaflets.

***Distribution and habitat*:** The species is endemic to the Wet Tropics bioregion of north-eastern Qld where it is known from the Mt Windsor Tableland and the Daintree N.P. near Black Mountain (**Map 6**). On the Mt Windsor Tableland it has been collected from small 'islands' of exposed rocky areas of granite surrounded by rainforest or in open forest dominated by *Syncarpia glomulifera*, *Callitris macleayanus*, *Croton insularis* and *Leptospermum amboinense* on granite near watercourses. In the Daintree N.P. it has been found in two different communities: an open forest of *Eucalyptus reducta* and *Syncarpia glomulifera* on a granite ridge; and on granite outcrops in a creek with scattered *Callistemon viminalis* and *Lophostemon confertus*.

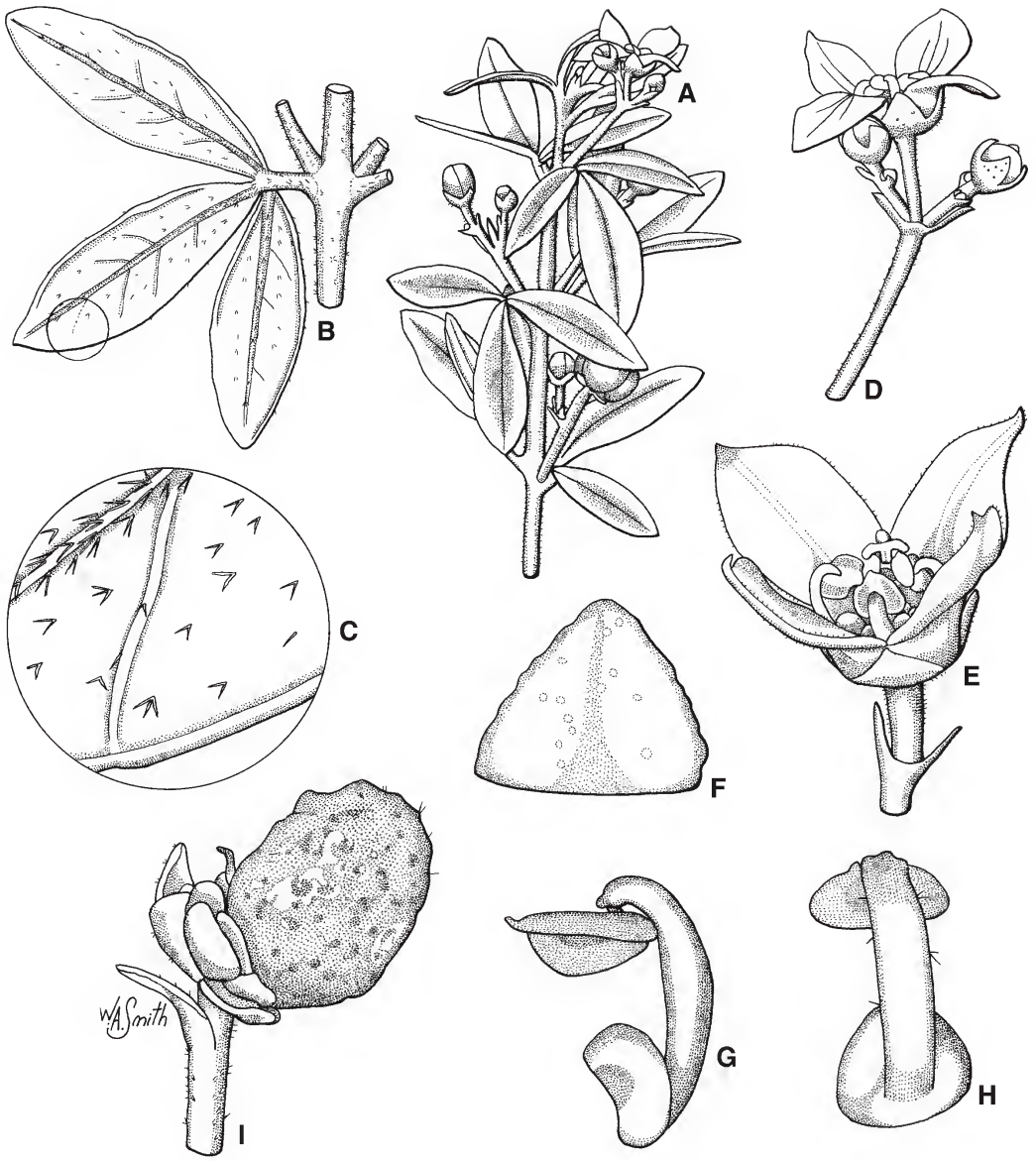

Fig. 12. ***Zieria insularis.*** A. branch with several flowering inflorescences × 2. B. stem node with abaxial view of leaf × 3. C. detail of indumentum on abaxial surface of leaflet × 16. D. inflorescence with buds and flower × 4. E. flower × 8. F. abaxial view of sepal × 20. G–H. views of stamens × 20. I. mature fruit with coccus × 8. All from *Forster PIF17246* (BRI). Del. W. Smith.

Usually the plants are found in saxicolous mat-forming vegetation comprised largely of monocotyledonous plants.

***Phenology*:** Flowers and fruit have been collected from January to July.

***Conservation status*:** This species can be locally common or rare, depending on the fire history of the locality. It has been collected only in National Parks and Forest Reserves; however, the areas of suitable habitat are relatively rare within a greater mosaic of either rainforest or fire prone vegetation. Other localised endemics that co-occur with *Zieria insularis* include *Plectranthus fasciculatus* P.I.Forst. and *Stylidium confertum* A.R.Bean.

The conservation status of this species can be assessed as **Near Threatened** on the basis of criterion D (IUCN 2001). Surveys are required to ascertain the number of populations, number of individuals and the area of occupancy. Perceived threats are invasions of the isolated granite outcrops by weeds, and too frequent fires.

***Etymology*:** The specific epithet is derived from the Latin adjective *insularis* (pertaining to islands) and refers to the occurrence of this species on islands of rock in a sea of rainforest.

21. Zieria laevigata Bonpl., *Descr. Pl. Malmaison* 64 (1815). **Type:** New South Wales. Central Tablelands: On rocky situations on the verge of Regent's Glen, Blue Mountains, 4 October 1822, *A.Cunningham 27* (neo [designated by Armstrong (2002: 378)]: K 347900 [images BRI, HO 534661]; isoneo: BRI [AQ318539]).

Zieria laevigata subsp. (Wyberba T.L.Ryan 37); Forster (2002: 181).

***Illustrations*:** Williams (1999: 387); Armstrong (2002: 380, 381).

***Additional selected specimens examined*:** Queensland. Darling Downs District: Amiens, 28°35′S, 151°48′E, Dec 1952, *Gordon DMG269* (BRI); Lyra, Nov 1959, *Blake 21096* (BRI); S.F. 263, near Amiens, Sep 1974, *McDonald 381* (BRI); on track to The Junction, Bald Rock Creek, Girraween N.P., 28°50′S, 151°55′E, Oct 2001, *Duretto 1429 & Jensz* (BRI, HO, MEL); Portion 90, Wyberba, 28°50′S, 151°54′E, Aug 1995, *Forster PIF17596 & Figg* (BRI, MEL); Upper reaches of Bald Rock Creek, Girraween N.P., 28°50′S, 151°58′E, Sep 1993, *Bean 6370 & Forster* (BRI, NSW).

***Notes*:** In 1992 Armstrong annotated some Darling Downs specimens of this species as a new subspecies; however, the proposed name was not published in the monograph (Armstrong 2002). He did comment that the collections may represent "a stabilised hybrid between *Z. laevigata* and *Z. aspalathoides*". This form (e.g. *Blake 21096*, *23715A*; *Clemens* AQ530716; *Duretto 1429* & *Jensz*; *Ryan 37*; *Schindler* AQ531220) can be distinguished from typical *Z. laevigata* (e.g. *Gordon DMG269*) by the stellate pubescence on the stems (versus glabrous), and from *Z. graniticola* (described above) by the dense indumentum on the abaxial surface of the leaves (versus glabrous) and may represent an undescribed taxon. Further field and laboratory studies are required to ascertain the taxonomic status of this form.

***Distribution and habitat*:** This species is widespread from southern NSW through to the 'Granite Belt' near Stanthorpe in Qld within the New England Tableland bioregion (**Map 7**). Plants grow in shrubland or heathland on granite pavement, often in association with *Eucalyptus prava*.

***Phenology*:** Flowers have been collected from August to December, and fruit from November to December.

***Conservation status*:** *Zieria laevigata* is restricted in its Qld occurrence; however, it is widespread and common over its total range. In Qld it is present in Girraween N.P. An appropriate conservation status is **Least Concern** (IUCN 2001).

22. Zieria laxiflora (Benth.) Domin, *Repert. Spec. Nov. Regni. Veg.* 12: 132 (1913); *Zieria laevigata* var. *laxiflora* Benth., *Fl. Austral.* 1: 304 (1863). **Type:** Queensland. Moreton District: Moreton Island, August 1855, *F.Mueller s.n.* (lecto [designated by Armstrong (2002: 388)]: K 347897 [images BRI, HO 534654]).

***Illustrations*:** Williams (1979: 281); Armstrong (2002: 386, 387); Haslam (2004: 64); Logan River Branch SGAP (QLD Region) Inc. (2005: 121).

***Corrections and additions to description given in Armstrong (2002)*:** Sepals 1.2–1.7 mm long, shorter than petals. Petals 3–4.5 mm long. Staminal filaments usually glabrous, rarely sparsely hirsute with simple and stellate hairs (e.g. *Batianoff 461 & McDonald*; *Fell 4535*).

***Additional selected specimens examined*: Queensland.** Port Curtis District: Port Clinton, 60 km N of Yeppoon, 22°30′S, 150°43′E, Aug 1993, *Sharpe 5420 & Thomas* (BRI); 4.5 km NW of Five Rocks, May 1996, *Fell 4535* (BRI); Shoalwater Bay, Dismal Sector, 22°43′S, 150°45′E, Jun 1999, *Brushe JB1934 & Power* (BRI); Emu Park, 15 km SE of Yeppoon, 23°15′S, 150°49′E, Jul 1977, *Batianoff 302 & McDonald* (BRI); Deepwater Creek N.P., on track to Deepwater Creek, 24°21′S, 151°58′E, Sep 1992, *Sharpe 5171* (BRI); 2 km W of Rules Beach, near Baffle Creek, NW of Bundaberg, 24°29′S, 152°00′E, Oct 1996, *Bean 11089* (BRI); S.F. 898, *c.* 6 km N of Watalgan, 24°36′S, 152°01′E, Aug

1996, *Bean 10532* (BRI); Littabella N.P., *c.* 40 km NW of Bundaberg, 24°38′S, 152°03′E, Nov 1993, *Bean 7014* (BRI). Wide Bay District: Great Sandy N.P., Fraser Island, Platypus Bay access track, 5.5 km WNW of Orchid Beach, 24°56′S, 153°15′E, Sep 2004, *Forster PIF30255 & Leiper* (BRI, HO); Kinkuna [now Burrum Coast] N.P. near Bundaberg, 25°03′S, 152°24′E, Jul 1996, *Leiper s.n.* (BRI [AQ653466]); 16 km from Old Bruce highway, towards Burrum Heads, 25°12′S, 152°36′E, Aug 1994, *Bean 7810* (BRI, MEL); Craignish, 25°17′S, 152°42′E, Aug 1996, *Forster PIF19517 et al.* (BRI, MEL); Between Lakes Benaroon & Boeminger, Fraser Island [Great Sandy N.P.], 25°32′S, 153°03′E, Sep 1986, *Russell-Smith 1787 & Lucas* (BRI); Poona N.P., 25°35′S, 152°50′E, Aug 1996, *Forster PIF19559 et al.* (BRI); Quarry off Freshwater road, Rainbow Beach road end, Cooloola, 25°56′S, 153°04′E, Sep 1994, *Grimshaw G946 & Turpin* (BRI, CANB); Mt Bilewilum [Great Sandy N.P.], 26°00′S, 153°02′E, Aug 1994, *Forster PIF15682* (BRI, K, MEL, NSW); Harry Springs Hut road, Cooloola [N.P.], 26°12′S, 152°59′E, Aug 1994, *Grimshaw G892 & Turpin* (BRI); Just E of S.F. 959, SW of Noosaville, 26°24′S, 153°01′E, Aug 1994, *Bean 7789* (BRI); Noosa N.P., 26°24′S, 153°06′E, Sep 1985, *Sharpe 3940 & Batianoff* (BRI). Moreton District: North Stradbroke Island, between Myora Swamp and main east coast road, 27°27′S, 153°26′E, Sep 1993, *Sparshott 135 & Holland* (BRI); Plunkett S.F. 766, Sep 1992, *Leiper s.n.* (BRI [AQ547466]).

***Notes*:** Armstrong (2002) indicated that the stamens of *Zieria laxiflora* are glabrous and that the sepals were almost equal to the petals. Both Armstrong (2002) and Armstrong & Harden (2002) use these features to separate this species from *Z. laevigata* (with hirsute stamens and sepals shorter than the petals) in their keys to species. This is confusing as both treatments indicate in the descriptions that the sepals (*c.* 1.7 mm) of *Z. laxiflora* are half the length of the petals (*c.* 3.4 mm): hardly 'equal to'. The description is amended above. During this study it was noted that some plants of *Z. laxiflora* from coastal areas to the north of the range of the species had stamens with hirsute filaments (see above and the key to species).

***Distribution and habitat*:** This species is widespread in coastal areas from central NSW, north to Shoalwater Bay in Qld within the Southeast Queensland bioregion (**Map 7**). *Zieria laxiflora* is an inhabitant of coastal wallum heathland on stabilised sand-dunes.

***Phenology*:** Flowers have been collected from May to August, and fruit from July to October.

***Conservation status*:** It is a common species in Qld, although many populations have been destroyed because of coastal development for agriculture, forestry, industry or housing. Populations are present in National Parks at Burrum Coast (Kinkuna), Cooloola, Deepwater, Fraser Island, Littabella, Noosa Heads, Shoalwater Bay and Stradbroke Island. An appropriate conservation status is **Least Concern** (IUCN 2001).

23. Zieria madida Duretto & P.I.Forst., **species nova** a *Z. montana* J.A.Armstr. floribus paucioribus in quaque inflorescentia (3–10 adversum 10–20+) et a *Z. alata* Duretto & P.I.Forst. foliolis obtusis (in illa acutis) differt. **Typus:** Queensland. Cook District: Thornton Peak, in valley between north and south peaks near campsite on Hilda Creek, 16°10′S, 145°22′E, 25 September 1984, *J.R.Clarkson 5587* (holo: BRI; iso: CANB, HO, K, L, NSW, QRS *distribuendi*)

Zieria sp. (Thornton Peak J.R.Clarkson 5556); Forster (1997b: 188; 2002: 181).

Zieria sp. (Pieter Botte M.Godwin C2471); Forster (1997b: 188; 2002: 181).

Shrub to 2 m tall, forming an open compact bush. Stems erect to somewhat decumbent, wiry; branches with prominently, raised decurrent leaf bases, not or slightly glandular verrucose, glabrous or simple and/or stellate glabrescent; older branches not or slightly lenticellate and corky, conspicuously scarred from the fallen buds and leaves. Leaves palmately trifoliolate; petioles 8–23 mm long, very slightly verrucose, glabrous or stellate glabrescent; terminal leaflets elliptic to obovate, 15–29 × 5–14 mm, laminae not glandular verrucose, glabrous, tips obtuse or rarely slightly acute (*Godwin 2471*), margins entire and flat; lateral leaflets similar to terminal leaflets and can be shorter or longer. Inflorescence axillary, shorter than the subtending leaf, 3–10-flowered with only 1–3 open at any one time; peduncle 4–13 mm long, with prominent ridges, not glandular verrucose, glabrous or glabrescent; bracts scale like, persistent, slightly glandular verrucose, stellate glabrescent; pedicels 1.5–2.2 mm long, prominently ridged, glandular verrucose, stellate tomentose. Sepals broadly

deltate, *c.* 0.7 × 1.2 mm, imbricate in bud, not or slightly glandular verrucose, tips acute, adaxial surfaces glabrous, abaxial surfaces sparsely stellate pubescent at the base. Petals elliptic, 3.5–3.7 × *c.* 2 mm, white to pale pink, dotted with pellucid glands abaxially, stellate pubescent on both surfaces. Staminal filaments 1.5–1.7 mm long, sparsely (*Godwin 2471*) to densely stellate pubescent, particularly towards the apex, not or very slightly glandular distally; anthers 0.8–1 mm long, apiculum absent. Ovary glabrous; style with scattered stellate hairs. Cocci *c.* 4 × 2.5 mm, smooth, glabrous. Seeds not observed. **Fig. 13.**

***Additional selected specimens examined*: Queensland.** Cook District: Timbercamp Creek on road between Daintree and Bloomfield Rivers, 16°01′S, 145°20′E, Aug 1972, *Webb & Tracey 12158* (BRI); Mt Pieter Botte, 16°05′S, 145°24′E, Jul 1983, *Godwin C2471* (BRI); Thornton Peak [Daintree N.P.], on plateau of summit between the campsite on Hilda Creek and the summit, 16°09′S, 145°22′E, Sep 1984, *Clarkson 5556* (BRI, CANB, HO, K); Hilda Creek, Thornton Peak, 16°10′S, 145°21′E, Sep 1992, *Le Cussan 148* (QRS); Thornton Peak, 16°10′S, 145°23′E, July 1979, *Hind 2429, 2431, 2434, 2438* (NSW); *loc. cit.*, 16°10′S, 145°23′E, Nov 1973, *Stocker 1099* (CANB, NSW); *loc. cit.*, Mar 1932, *Brass 2281* (BRI); *loc. cit.*, Sep 1937, *Brass & White 207* (BRI); *loc. cit.*, May 1967, *Olsen 413* (BRI); *loc. cit.*, Jun 1967, *Olsen 413* (NSW).

***Notes*:** Specimens of this species were included in the broadly circumscribed *Zieria montana* by Armstrong (2002). *Zieria madida* differs most noticeably from *Z. montana* by the leaflets that are entire (versus crenulate), fewer flowers per inflorescence (3–10, versus 10–20+) and pedicels that are prominently ridged and glandular verrucose (versus slightly ridged and not glandular verrucose). Differences between *Z. madida* and *Z. alata* are outlined under the account of the latter species.

There is some noteworthy variation in *Z. madida* that requires field research: *Webb & Tracey 12158* is more glandular verrucose than other specimens and apparently from a fairly low altitude; and the leaflets of *Godwin 2471* are more acute than those of other collections.

***Distribution and habitat*:** The species is endemic to north-eastern Qld where it has been found on and around Thornton Peak and Mt Pieter Botte within the Wet Tropics bioregion (**Map 6**). It has been collected from a variety of communities including clefts and crevices in *Borya* patches, low closed forest and heath, all usually in exposed, windswept situations on granite over 900 m. *Webb & Tracey 12158* was collected at around 200 m at the edge of a rock outcrop in complex mesophyll vineforest on riverine levee.

***Phenology*:** Flowers have been collected in June, September and November, and fruit in September.

***Conservation status*:** *Zieria madida* can be common where found and there are no immediate threats; however, the known area of occupancy is small and there are no additional areas of potential habitat in the vicinity. Surveys are required to determine the number of populations, number of individuals and the area of occupancy. The species is present in Daintree N.P. at Thornton Peak. A conservation status of **Near Threatened** based on criterion D (IUCN 2001) is recommended.

***Etymology*:** The specific epithet is derived from the Latin adjective *madidus* (moist) and refers to the wet and misty habitat on the summits of Thornton Peak and Mt Pieter Botte.

24. Zieria minutiflora Domin, *Biblioth. Bot.* 89: 283 (1926). Based on *Boronia minutiflora* F.Muell., *Fragm.* 1: 100 (1858), *nom. illeg.* (see Armstrong 2002). **Type:** Queensland. Moreton District: Glasshouse Mountains, Moreton Bay, 1857, *F.Mueller s.n.* (lecto [designated by Armstrong (2002: 393)]: MEL 62124; isolecto: K [Herbarium Hookerianum; 2 sheets]).

Zieria minutiflora and *Z. obovata* appear to be closely related (see notes under the latter species). Armstrong (2002) considered that this species comprised two subspecies, both of which occur in Qld.

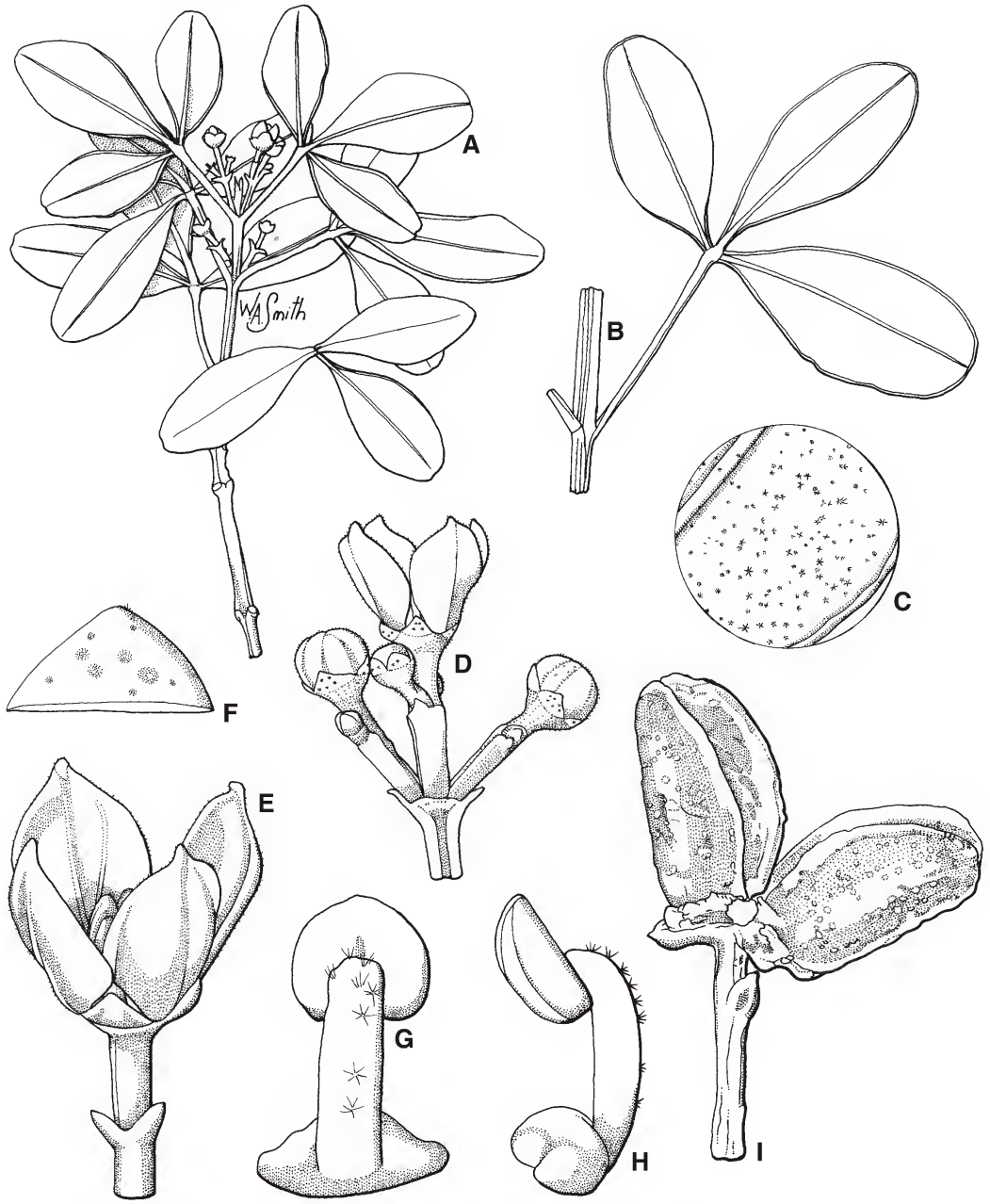

Fig. 13. ***Zieria madida.*** A. branch with several flowering inflorescences × 1.5. B. stem node with abaxial view of leaf × 1.5. C. detail of indumentum on abaxial surface of leaflet × 8. D. inflorescence with buds and flower × 4. E. flower × 8. F. tip of abaxial side of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. A, C & I from *Brass 207* (BRI); B, D–H from *Clarkson 5587* (BRI). Del. W. Smith.

Key to the subspecies of *Z. minutiflora*

1. Ovary and fruit glabrous; pedicels and peduncles glabrous or glabrescent . . . . . subsp. **minutiflora**
   Ovary and fruit hirsute; pedicels and peduncles hirsute, rarely glabrescent . . . . . subsp. **trichocarpa**

24a. Zieria minutiflora subsp. **minutiflora**

***Illustrations*:** Williams (1987: 319) [as *Z. minutiflora*]; Armstrong (2002: 394, 395); Haslam (2004: 114); Logan River Branch SGAP (QLD Region) Inc. (2005: 176).

***Additional selected specimens examined*: Queensland.** Wide Bay District: 1 km W of Butler's Knob, 16 km N of Gympie, 26°03′S, 152°41′E, Oct 1993, *Bean 6692* (BRI); Tewantin S.F. 969, between Tewantin and Cooroy, 26°23′S, 153°00′E, Feb 1994, *Grimshaw G482* (BRI); Conondale Range, S.F. 274 Conondale, *c.* 1.5 km E of Funnels Hut road turnoff on Jimna – Kenilworth road, 26°40′S, 152°37′E, Oct 1982, *McDonald 3657 & Williams* (BRI). Moreton District: York Creek, 6 km NW of Yandina, 26°32′S, 152°54′E, Apr 1993, *Bean 5947* (BRI); S.F. 783, 4 km NW of Montville, 26°39′S, 152°51′E, May 2001, *Forster PIF27106 et al.* (BRI, MEL, NSW); Adjacent to corner of Sunshine Motorway & Mooloolabah road, Buderim, 26°40′S, 153°05′E, Sep 2002, *Forster PIF28821* (A, BRI, CANB, L, MEL, MO, NSW, NY); Summit of Mt Ngungun, Glasshouse Mtns [N.P.], 26°54′S, 152°55′E, May 1993, *Powell 4611* (BRI, NSW *n.v.*); 1 km NNE of Mt Tibrogargan, N of Beerburrum, 26°55′S, 152°57′E, Feb 1997, *Bean 11660* (BRI); Diana's Bath area, D'Aguilar Range, 9 km E of Somerset Dam, 27°06′S, 152°38′E, Jun 1993, *Forster PIF13347 et al.* (BRI); S.F. 893, Mt Mee, 27°06′S, 152°42′E, Aug 1995, *Forster PIF17376* (BRI, MEL).

***Distribution and habitat*:** This subspecies is widespread from near Coffs Harbour in NSW through south-eastern Qld with a northern limit just north of Gympie within the Southeast Queensland bioregion (**Map 6**). It is found as an understorey bush in woodland dominated by eucalypts such as *Corymbia citriodora*, *Eucalyptus acmenoides, E. dura, E. microcorys*, *E. pilularis, E. racemosa* and *Syncarpia glomulifera* usually on metamorphic substrates, volcanics or on trachyte in the Glasshouse Mountains (not granite as stated by Armstrong 2002).

***Phenology*:** Flowers and fruit have been collected throughout the year.

***Conservation status*:** This subspecies is widespread and common and is present in various National Parks including Conondales, Coolum, Glasshouse Mountains, Noosa and Mooloolah River. An appropriate conservation status is **Least Concern** (IUCN 2001).

24b. Zieria minutiflora subsp. **trichocarpa** J.A.Armstr., *Austral. Syst. Bot.* 15: 396 (2002). **Type:** Queensland. North Kennedy District: 3.8 km S of Ravenshoe Post Office, on the Tully Falls road, 17°39′S, 145°31′E, 7 September 1977, *J.A.Armstrong 1022 & D.F.Blaxell* (holo: NSW 458956; iso [as per Armstrong (2002)]: BRI, MEL *n.v.* [specimen could not be located], CANB [CANB 333073, CBG 8208513], PERTH *n.v.*).

Zieria sp. 12 (sp. "L"; Russell River, S.Johnson s.n., 1892 [189]); Briggs and Leigh (1996: 170, 290).

Zieria sp. (Russell River S.Johnson in 1892); Forster (1997b: 188).

Zieria minutiflora subsp. (Danbulla L.J.Webb 5732); Forster (2002: 181).

***Illustrations*:** Pearson & Pearson (1992: 213) [as *Z. minutiflora*]; Armstrong (2002: 397).

***Additional selected specimens examined*: Queensland.** Cook District: Danbulla, Feb 1962, *Webb 5732 & Tracey* (BRI); S.F.R. 185, Platypus L.A., 17°10′S, 145°30′E, Feb 1972, *Stevens 375 & Dockrill* (BRI, QRS); SW of extension of Gadaloff road, Gadgarra S.F., 17°19′S, 145°42′E, Apr 1995, *Horton SH114A* (BRI); Hillcrest on Old Mailmans track [Wooroonooran N.P.], 17°20′S, 145°43′E, Feb 1995, *Hunter JH232* (BRI); road to Windin Falls from S side of basin, 17°20′S, 145°44′E, Mar 1995, *Hunter JH2586* (BRI); S.F.R. 194, Atherton, Nov 1973, *Hartley 14153* (BRI, CANB *n.v.*); Stuart Head, 4.5 km E of Herberton, 17°23′S, 145°26′E, Jan 1998, *Wannan BSW535* (BRI); Towalla lookout, 17°27′S, 145°46′E, May 1995, *Jago 3436* (BRI); S.F. 488, near Ravenshoe, 17°38′S, 145°29′E, Mar 2004, *McDonald KRM1910* (BRI). North Kennedy District: Rapid Creek, Princess Hills section of Lumholtz N.P., 18°23′S, 145°36′E, May 1994, *Cumming 13023* (BRI); 32 km S of Cardwell, Bishops Peak, eastern spur, 18°28′S, 146°08′E, Nov 1991, *Halford Q711* (BRI); Bishop Peak, Hinchinbrook Channel N.P., N of Ingham, 18°29′S, 146°08′E, May 1991, *Bean 3254* (BRI). South Kennedy District: Dicks Tableland, Eungella N.P., 20°59′S, 148°31′E, Sep 1991, *Bean 3666* (BRI). Port Curtis District: Shoalwater

Bay, Mt Parnassus sector, 22°51′S, 150°34′E, Jun 1999, *Brushe JB1933 & Power* (BRI); near Mt Atherton, Dec 1992, *Melzer RM72* (BRI); Upper Stony Creek area in Bowenia S.F., *c.* 30 km NNW of Yeppoon, May 1982, *Anderson 3034* (BRI); Byfield, Keppel Bay, Sep 1931, *White 8040* (BRI). LEICHHARDT DISTRICT: Blackdown Tableland [N.P.], *c.* 35 km SE of Blackwater, campsite at old stockyard on Mimosa Creek, Sep 1971, *Henderson H1164 et al.* (BRI).

***Distribution and habitat*:** This subspecies is endemic to Qld within the Brigalow Belt, Central Queensland Coast, Einasleigh Uplands and Wet Tropics bioregions and is widespread with a northern limit at Danbulla on the Atherton Tablelands and a southern, somewhat disjunct limit at Blackdown Tableland (**Map 6**). Recent collections have partially filled in the distributional gap north of Byfield as mapped by Armstrong (2002). The subspecies occurs in woodland dominated by eucalypts on a wide range of substrates including sandstone and granite.

***Phenology*:** Flowers have been collected from January to November and fruit from February to October.

***Conservation status*:** *Zieria minutiflora* subsp. *trichocarpa* is common and widespread with populations in National Parks such as Blackdown Tableland, Eungella, Hinchinbrook Channel, Lumholtz and Wooroonooran. An appropriate conservation status is **Least Concern** (IUCN 2001).

25. Zieria montana J.A.Armstr., *Austral. Syst. Bot.* 15: 398 (2002). **Type:** Queensland. MORETON DISTRICT: Mt Barney, in saddle between east and west peaks, 26 September 1977, *J.A.Armstrong 1142 & J.Powell* (holo: NSW 368627; iso [as per Armstrong (2002)]: AD *n.v.*, BRI, CANB 559205, K *n.v.*, MEL *n.v.* [specimen could not be located], PERTH *n.v.*).

***Illustrations*:** Armstrong (2002: 399, Fig. 86A,B,D,E).

Shrub to 2.5 metres tall, forming an open compact bush. Stems erect, wiry; branches very prominently ridged, conspicuously scarred from the fallen buds and leaves, slightly glandular verrucose when young, glabrous to glabrescent; older branches lenticellate and corky. Leaves palmately trifoliolate; petioles 10–20 mm long, slightly glandular verrucose, glabrous or glabrescent; terminal leaflets elliptic to obovate, 20–45 × (5–) 10–17 mm, laminae not glandular verrucose, tips obtuse, margins flat, thickened, crenulate (particularly towards the tip), midveins raised abaxially, secondary venation obscure, adaxial surfaces glabrous except for scattered hairs along midvein, abaxial surfaces glabrous; lateral leaflets similar to terminal leaflets, smaller or longer. Inflorescence axillary, shorter than the subtending leaf, 10–20^{+}-flowered, all or most of flowers opening at once, not or slightly glandular verrucose, sparse indumentum of stellate hairs; peduncle 5–17 mm long, ridged; bracts scale or leaf like, deciduous, to 5 mm long, slightly verrucose, stellate pubescent on both surfaces; pedicels slightly ridged, 1.5–4 mm long, not glandular verrucose, stellate tomentose. Sepals broadly to transversely ovate, 0.7–1 × *c.* 1 mm, valvate or slightly imbricate in bud, very slightly glandular verrucose, tips obtuse, adaxial surfaces glabrescent, abaxial surfaces stellate glabrescent to pubescent at the base. Petals elliptic to broad elliptic, 4–4.5 × *c.* 2 mm, white, fringed with pink, imbricate in bud, dotted with pellucid glands, stellate pubescent on both surfaces. Staminal filaments *c.* 1.8 mm long, glabrous or hirsute with stellate hairs particularly towards the apex, not or slightly glandular verrucose distally; anthers *c.* 0.8 mm long, apiculum absent. Gynoecium glabrous. Cocci [mature not observed] slightly glandular verrucose, glabrous, base of style persistent forming a minute apical apiculum. Mature seeds not observed.

***Additional selected specimens examined*: Queensland.** MORETON DISTRICT: Mt Barney [N.P.], south slopes, 28°17′S, 152°41′E, Oct 1992, *Forster PIF11879 et al.* (BRI, MEL); Mt Barney, Rum Jungle, 28°17′S, 152°41′E, Sep 1994, *Forster PIF15724* (BRI, HO, MEL); Vicinity of hut, Mt Barney, Dec 1974, *McDonald 759* (BRI); Mt Barney, 28°17′S, 152°42′E, Jun 1972, *Bell 535* (BRI).

***Notes*:** Armstong (2002) included specimens from Mt Barney (south-east Qld) to the Thornton Peak area (north-east Qld) in his concept of *Zieria montana*. He noted that specimens from Mt William (Eungella N.P., central Qld) had smaller leaves than plants from other areas. The material from Mt William is recognised here as a distinct

species, *Z. eungaellensis* (see above). Other populations from Qld are here described as *Z. alata* (Mt Lewis area, Cook District), *Z. madida* (Thornton Peak area, Cook District), *Z. boolbunda* (Mt Perry area, Burnett District) and *Z. scopulus* (Mt Elliot and Flinders Peak, Moreton District). The collection from Hinchinbrook Island (*Fell DF1230*) cited by Armstrong (2002) under *Z. montana* is actually a specimen of *Z. robertsiorum* (see below).

Material illustrated as *Zieria montana* (Logan River Branch (SGAP Qld Region Inc.) 2005) and that originated from the Lions road to the Pinnacle in northern NSW (G.Leiper *pers. comm.* Jan 2006) is not supported by vouchers and its taxonomic status is uncertain.

***Distribution and habitat*:** *Zieria montana* is endemic to Qld and is restricted to Mt Barney within the Southeast Queensland bioregion (**Map 4**). It is found in clefts and crevices on rocky, granophyre (Willmott 2004) outcrops in low heath or microphyll moss/fern thicket.

***Phenology*:** Flowers have been collected from September to December. Fruiting time is unknown.

***Conservation status*:** All known populations of this species are found in Mt Barney N.P. A conservation status of **Vulnerable** based on the criterion D2 (IUCN 2001) is appropriate for this species. Surveys are required to determine the number of populations, number of individuals and an area of occupancy. Perceived threats are too frequent fires in the habitat and localised destruction of plants by bushwalkers.

26. Zieria obovata (C.T.White) J.A.Armstr., *Austral. Syst. Bot.* 15: 408 (2002); *Zieria aspalathoides* A.Cunn.ex Benth. var. *obovatum* C.T.White, *Proc. Roy. Soc. Queensland* 53: 208 (1942). **Type:** Queensland. North Kennedy District: Herberton, January 1912, *F.H.Kenny s.n.* (holo: BRI [AQ337221]).

Zieria sp. (Herberton J.A.Armstrong 1025); Forster (1997b: 188).

***Illustrations*:** Armstrong (2002: 409, 410).

***Correction to description given in Armstrong (2002)*:** Adaxial surfaces of leaflets glabrescent to sparsely pilose.

***Additional selected specimens examined*: Queensland.** North Kennedy District: Wild River Gorge, 5 miles [8.3 km] from Herberton, 17°22′S, 145°25′E, Jun 1972, *Wrigley & Telford NQ750* (CANB); Wild River, Herberton, 17°23′S, 145°23′E, Mar 1996, *Jago 3834* (BRI); 2 km W of Herberton, 17°23′S, 145°23′E, Dec 2000, *Freeman 'Rush Track 13'* (BRI); Herberton, Macleod Street trail, 17°23′S, 145°23′E, Feb 2003, *Holmes 211 & Holmes* (BRI); Herberton Weir, Wild River, S branch, 17°23′S, 145°25′E, Feb 1990, *Forster PIF6251* (BRI); Wild River Dam, 17°24′S, 145°24′E, Feb 1989, *Jones 3530* (CANB); Herberton, Atherton road, mountain to west of Caravan Park, Jun 1975, *Sharpe 1458* (BRI).

***Notes*:** *Zieria obovata* is closely related to *Z. minutiflora*. Armstrong (2002: 411) said that the former differs from the latter by 'having non-emarginate lamina that are glabrous on the upper surface'. His description of *Z. obovata* (p. 408) indicated that the adaxial surfaces of the leaves are glabrescent with the hairs confined to the midrib or scattered over the surface. Specimens seen of *Z. obovata* have adaxial leaflet surfaces that are glabrescent to sparsely pilose while those of *Z. minutiflora* are densely pilose. The leaflets of *Z. minutiflora* are not always emarginate. The main distinguishing character that can be used to separate the species is the relative size of the inflorescence: in *Z. obovata* they are longer than the leaves and in *Z. minutiflora* they are usually shorter, at least at anthesis. Field and laboratory research is required to ascertain if the recognition of *Z. obovata* as a species distinct from *Z. minutiflora* is warranted.

***Distribution and habitat*:** *Zieria obovata* is endemic to Qld with a restricted distribution in the area around Herberton within the Wet Tropics bioregion (**Map 4**). The species occurs in wet open eucalypt forest in rocky areas based on granite substrates. Specimens purportedly collected from Trinity Bay in 1882 (*Fitzgerald s.n.* [MEL622969 & 62274]); listed by Armstrong (2002) under *Infraspecific variation* and *Specimens Examined* only) are assumed to have erroneous locality information.

***Phenology*:** Flowers and fruits have been collected from September to March and in June.

***Conservation status*:** *Zieria obovata* should be allocated a similar conservation status to co-occurring near endemics such as *Parsonsia wildensis* J.B.Williams (Rare with a 2006 reassessment recommending that this be changed to Vulnerable) or *Tylophora rupicola* P.I.Forst. (Endangered). An appropriate conservation status is **Vulnerable** based on the criterion D2 (IUCN 2001). Surveys are required to determine the number of populations, number of individuals and the area of occupancy.

27. Zieria rimulosa C.T.White, *Proc. Roy. Soc. Queensland* 53: 210 (1942). **Type:** Queensland. Cook District: Mt Mulligan, 21 April 1931, *McDonald 450* (holo: BRI [AQ520879], iso: QRS).

***Illustrations*:** Armstrong (2002: 428, 429).

***Additional specimens examined*:** Cook District: Reedy Creek, Carbine Tableland, 16°24′S, 145°11′E, Aug 2003, *Burnett KRM1919* (BRI); Mt Mulligan, *c.* 40 km NW of Dimbulah, 16°54′S, 144°51′E, Sep 1986, *Clarkson 6587* (BRI, CANB); *loc. cit.*, Apr 1985, *Clarkson 5926* (BRI, CANB, MEL); *loc. cit.*, Apr 1985, *Clarkson 5802* (BRI, MEL).

***Distribution and habitat*:** This species is endemic to north Qld and known from Mt Mulligan and the Carbine Tableland within the Einasleigh Uplands bioregion (**Map 4**). Plants occur on sandstone pavement or clifflines.

***Phenology*:** Flowers and fruits have been collected in April.

***Conservation status*:** This species is listed as **Vulnerable** in Qld (*NCR* 2006).

28. Zieria robertsiorum J.A.Armstr., *Austral. Syst. Bot.* 15: 429 (2002). **Type:** Queensland. Cook District: Mt Finnigan, 7 September 1948, *L.J.Brass 20113* (holo: BRI; iso [as per Armstrong (2002)]: CANB *n.v.*).

***Illustrations*:** Armstrong (2002: 431, 432).

Shrub to 2 m tall, forming an open compact bush. Stems erect to decumbent, wiry; branches with slight to prominently decurrent leaf bases, not glandular verrucose, with a moderately dense indumentum of mainly stellate hairs evenly spread around branches, becoming glabrous with age. Leaves palmately trifoliolate, not or very rarely slightly glandular verrucose; petioles 2.5–10 mm long, glabrescent or having a sparse to moderately dense stellate indumentum; terminal leaflets elliptic to obovate, 6–23 (–28) × 2.5–11 mm, tips obtuse or slightly acute (Hinchinbrook Is.), margins entire, flat or slightly recurved (sometimes revolute on drying), midribs on abaxial surfaces raised, secondary veins obscure, adaxial surfaces with few hairs along midribs or with a sparse to moderately dense stellate indumentum, abaxial surfaces with a sparse to moderately dense stellate indumentum, sometimes only on midribs (Malbon Thompson & Lamb Ranges); lateral leaflets similar to terminal leaflets though usually shorter. Inflorescence axillary, shorter than or nearly equal to subtending leaf, usually 3–10-flowered though only 1–3 flowers open at any time, not glandular verrucose, with a sparse to moderately dense stellate indumentum; peduncle 1.5–12 mm long; bracts scale to leaf like, persistent, to 3 mm long; pedicels 2.5–4.5 mm long. Sepals almost semi-circular to broadly deltate, 0.7–1 × 1–1.2 mm, slightly imbricate in bud, not or slightly glandular verrucose, tips obtuse to acute, adaxial surfaces with scattered appressed simple and stellate hairs, abaxial surfaces with a dense stellate indumentum though this sometimes confined to the base. Petals elliptic, 1.5–3.5 × 1.2–1.5 mm, white, dotted with pellucid glands; adaxial surfaces with a dense stellate indumentum, abaxial surfaces with a moderately dense stellate indumentum, denser along margins. Staminal filaments *c.* 1.5 mm long, glabrous or glabrescent or with scattered stellate hairs, slightly glandular or not at tip; anthers *c.* 0.6 mm long, apiculum absent. Ovary glabrous or with a sparse stellate indumentum; style glabrous. Cocci *c.* 3 × 2 mm, smooth, glabrous, base of style persistent forming a minute apical apiculum. Seeds oblong-ovoid, 2–2.5 × 1.2–1.5 mm, black, dull, longitudinally striate.

***Additional specimens examined*:** **Queensland.** Cook District: Mt Finnigan, S of Cooktown, Dec 1991, *McDonald s.n.* (BRI [AQ520392]); Cedar Bay N.P., Mt Finnigan summit area above Horans Creek, 15°49′S, 145°16′E, Oct 1999, *Forster PIF25031 & Booth* (BRI); Mt Finnigan, on summit, 15°49′S, 145°18′E, Sep 1992, *Armstrong 1032* (CANB, NSW); S.F.607, Kahlpahlim Rock, Lamb Range, 17°01′S, 145°37′E, May 2000, *Forster PIF25766 et al.* (BRI, HO, MEL, NSW); *loc. cit.*, Apr 2005, *Forster PIF30637 et al.* (BRI, HO); Hilltop

0.5 km SE of Kahlpahlim Rock with telecommunications, Jul 2000, *Wannan 1845* (CANB); Kahlpahlim Rock, Jul 2000, *Wannan 1844* (BRI); Lamb Range, near summit Lamb's Head, 17°01′S, 145°38′E, Mar 1992, *Le Cussan 81* (QRS); Lamb's Head, Lamb Range, 17°02′S, 145°38′E, *s.dat.*, *Godwin s.n.* (BRI [AQ408269]); Bell Peak, *c.* 15 km E of Gordonvale, 17°05′S, 145°52′E, Jul 1995, *Jago 3531* (BRI); North Bell Peak, summit area, Malbon Thompson Range, 17°05′S, 145°52′E, Nov 1995, *Forster PIF18047 et al.* (BRI, MEL); Bell Peak, 17°07′S, 145°52′E, 1996, *Godwin C4293 et al.* (BRI). North Kennedy District: Hinchinbrook Island, Mt Bowen summit, [Hinchinbrook Channel N.P.] 18°21′S, 146°15′E, Jul 1988, *Fell DF1230* (CANB); Hinchinbrook Island, ridge 1 km N of Mt Bowen, Aug 1975, *Hockings s.n.* (BRI [AQ229910]); *c.* 2 km NW of Mt Diamantina [Hinchinbrook Channel N.P.], 18°25′S, 146°17′E, Dec 2000, *Kemp TH2504* (BRI).

***Notes*:** Armstrong (2002) indicated that the sepals or calyx lobes of *Zieria robertsiorum* are almost semi-circular with an obtuse to rounded apex. Though most of the material from the type locality (the summit of Mt Finnigan) do have sepals of this nature, others (e.g. *McDonald s.n.* (BRI [AQ520392])) have sepals with an acute apex. The density of the indumentum on the abaxial surfaces of the sepals also varies at Mt Finnigan: the indumentum may be dense and evenly spread over the entire surface or more or less confined to the base of the sepal. Specimens from further south have sepals with acute tips and with the indumentum more or less confined to the base on the abaxial surfaces. Sepals of this nature are similar to those of *Z. smithii* subsp. *tomentosa sensu* Armstrong (2002). *Z. smithii* subsp. *tomentosa* has leaflets with acute tips (versus usually obtuse in *Z. robertsiorum*) and branches without obvious decurrent leaf bases (versus obvious). The specimens collected from Hinchinbrook Island have a sparse to moderately dense stellate indumentum on the adaxial surfaces of the leaves (versus glabrescent) and ovary (versus normally glabrous).

Armstrong (2002) indicated that the branches of *Zieria robertsiorum* were prominently ridged. Though the branches do have decurrent leaf bases that can be prominent they are not always so and thus may prove problematic when using his key.

Further field and laboratory research is required to determine if the morphological differences between the disjunct populations of *Zieria robertsiorum* warrants taxonomic recognition. This research should include surveys of intervening areas of similar habitat. Any detailed study of variation in *Z. smithii* (see discussion under that species) should also include *Z. boolbunda* and *Z. robertsiorum*.

A specimen of *Zieria eungellaensis* from Mt David (*Bean 4435*) in the Mackay area, is superficially similar to *Z. robertsiorum* but differs in having leaflets with acute (versus obtuse) tips and a sparse indumentum of simple and bifid hairs (versus a sparse to moderately dense stellate indumentum) on the abaxial surface. See further discussion under *Z. eungellaensis*.

***Distribution and habitat*:** *Zieria robertsiorum* is endemic to north-eastern Qld where it is restricted to the Wet Tropics bioregion (**Map 11**). Armstrong (2002) stated that this species was restricted to the "summit of Mt Finnegan [sic]"; however various collections, mostly since the 1980s, have revealed that it is found also to the south on the Malbon Thompson and Lamb Ranges, and on Mt Bowen and Mt Diamantina on Hinchinbrook Island. In all cases it has been collected in clefts and crevices in windswept shrubland in granite boulderfields or pavements at or above 1000 m, often in saxicolous mats composed of sedges and other monocotyledonous plants. This community type is usually clearly delimited from the surrounding vegetation of upland rainforest.

***Phenology*:** Flowers have been collected from May to December, and fruit from July to December.

***Conservation status*:** This species may be locally common and is present in Cedar Bay and Hinchinbrook Channel National Parks and a number of Forest Reserves and State Forests. There are no perceived current threats. An appropriate conservation status is **Least Concern** (IUCN 2001).

29. Zieria scopulus Duretto & P.I.Forst., **species nova** a *Z. montana* J.A.Armstrong foliolis minoribus (11–25 × 2–9 mm adversum 20–45 × (5–) 10–17 mm), foliis basi infirme decurrentibus (non manifeste decurrentibus)

et floribus in inflorescentiis omnibus in sequentia maturantibus (non coaetaneis); et a *Z. actites* Duretto & P.I.Forst. caulibus glandulari-verrucosis (non glabris) differt. **Typus:** Queensland. Moreton District: Mt Elliot, 30 km S of Ipswich, 31 May 1990, *L.H.Bird s.n.* (holo: BRI [AQ472279]; iso: CANB).

Zieria sp. (Flinders Peak S.L.Everist 1169); Forster (2007: 183).

Shrub to at least 1 m, forming an open compact bush. Stems erect, wiry; branches with decurrent leaf bases, sometimes faintly so, weakly glandular verrucose with occasional prominent gland, glabrous. Leaves palmately trifoliolate; petioles 5–11 mm long, very slightly glandular verrucose, glabrous or glabrescent; terminal leaflets elliptic or slightly ovate, 11–23 × 3–9 mm, laminae not glandular verrucose, tips acute, margins crenulate, especially in distal half, flat to slightly recurved (sometimes revolute on drying), midribs raised abaxially, secondary veins obscure, glabrous apart from few simple hairs on the proximal portion of the midribs on the adaxial surfaces; lateral leaflets similar to terminal leaflets though may be slightly longer or shorter. Inflorescence axillary, shorter to slightly longer than the subtending leaf, 1–20-flowered though only 1–3 flowers open or in fruit at any one time, not glandular verrucose; peduncle 4–18 mm long, glabrous or glabrescent with stellate hairs; bracts scale like, persistent, to 1 mm long, glabrescent; pedicels 2.5–5 mm long, glabrous or glabrescent with stellate hairs. Sepals deltate, 0.7–1 × 0.7–1 mm, valvate in bud, not glandular verrucose, tips acute, glabrous. Petals elliptic, 2–2.5 × *c.* 1.5 mm, white, valvate in bud, dotted with pellucid glands, adaxial surfaces densely stellate pubescent along margins, pilose centrally, abaxial surfaces densely stellate pubescent along margins, sparsely stellate pubescent centrally. Staminal filaments 1–1.2 mm long, glabrous, slightly glandular towards apex; anthers *c.* 0.6 mm long, apiculum absent. Gynoecium glabrous. Cocci 3–4.5 × 2–2.5 mm, smooth, glabrous, base of style sometimes persistent forming a minute apical apiculum. Seeds oblong-ovoid, *c.* 2.7 × 1.5 mm, black, dull, longitudinally striate. **Fig. 14.**

***Additional specimens examined*:** Moreton District: Flinders Peak, Jun 1935, *Everist 1155 & 1169* (BRI).

***Notes*:** Collections of *Zieria scopulus* were included by Armstrong (2002) in his concept of *Z. montana*; however it differs from that species by the smaller leaves, less pronounced decurrent leaf bases and by having flowers on any one inflorescence that mature in a staggered manner (versus simultaneously). *Z. scopulus* appears to be related to *Z. actites* (described above) though it differs noticeably from that species in having stems that are weakly glandular verrucose (versus smooth).

***Distribution and habitat*:** This species is apparently confined to Flinders Peak and Mt Elliot, near Ipswich, South-East Queensland bioregion (**Map 12**). On Flinders Peak it is found growing in cracks and crevices on trachytic tuff on the top and on the south-western side of the mountain. At Mt Elliot it is found on steep, stony ridges and clifflines of trachyte. The 'Flinders Group' of plugs and dykes includes Flinders Peak, Ivory's Rock, Mts Blaine, Elliot, Goolman and Perry; all are composed of various types of trachyte (Willmott 2004).

***Phenology*:** Flowers and fruit have been collected in May and June.

***Conservation status*:** The collector's notes indicate that the species was common on the south-western side of Flinders Peak (a council controlled Conservation Park) though not common at the summit. There is no data on the size of the population at Mt Elliot. On the basis of the highly restricted distribution, this species can be assessed as **Vulnerable** on the basis of the D2 criterion (IUCN 2001).

Etymology: The specific epithet is derived from the Latin *scopulus* (rock, cliff or crag) and alludes to the populations of this plant occurring on isolated rocky peaks. This is intended as a noun in apposition.

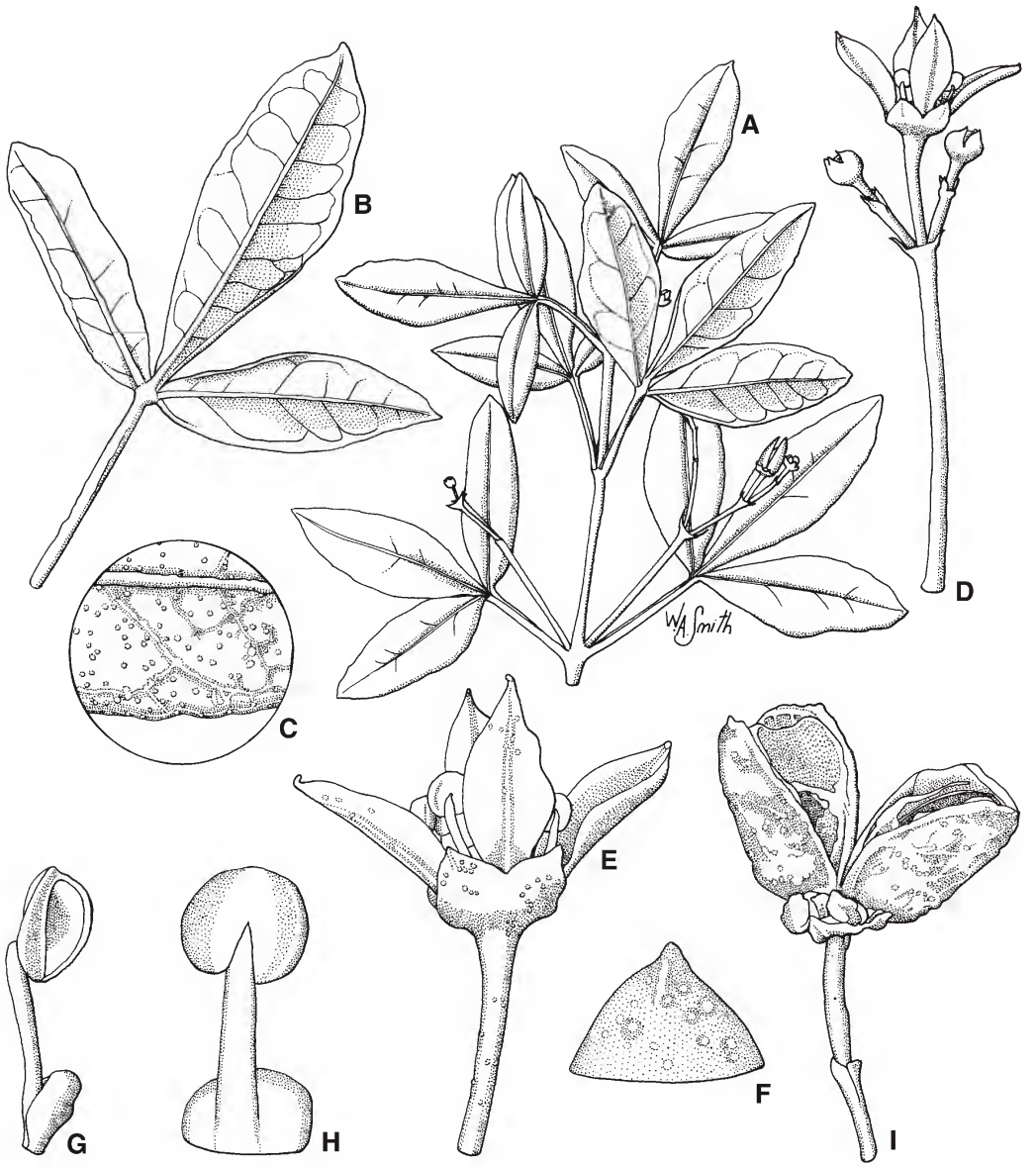

Fig. 14. ***Zieria scopulus.*** A. branch with several budding and fruiting inflorescences × 1.5. B. abaxial view of leaf × 3. C. detail of indumentum on abaxial surface of leaflet × 8. D. inflorescence with flower and buds × 4. E. flower × 8. F. tip of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. A–C, I from *Bird s.n.* (BRI [AQ472289]); D–H from *Everist 1169* (BRI). Del. W. Smith.

30. Zieria smithii Jacks. in Andrews, *Bot. Repos.* 9: t. 606 (1810). **Type:** "Communicated last April by A.B.Lambert, esq., from his collection..." (lecto [icono]: Andrews *ibid, t. 606* [designated by Armstrong (2002: 436)]).

Zieria smithii subsp. *tomentosa* J.A.Armstr., *Austral. Syst. Bot.* 15: 440 (2002), **syn. nov. Type:** Queensland. Cook District: Just above Walsh Falls on the Wallum Trig Road, *c.* 6.5 km N of Atherton, 17°16′S, 145°25′E, 9 September 1977, *J.A.Armstrong 1027 & J.M.Powell* (holo: BRI; iso [as per Armstrong (2002)]: CBG *n.v.*, MEL 2067265, NSW 433230 *n.v.*, PERTH *n.v.*)

Zieria sp. (Mt Ballow, G.Leiper AQ473220); Forster (1997b: 188; 2002: 181; 2007: 183).

***Illustrations*:** Pearson & Pearson (1989: 405); Hauser & Blok (1998: 368); Armstrong (2002: 438, 439, 441, 442); Haslam (2004: 312); Logan River Branch SGAP (QLD Region) Inc. (2002: 328) [as *Z.* sp. Mt Ballow].

***Additional selected specimens examined*: Queensland.** Cook District: Davies Creek, Aug 1999, *Wannan 1393 & Wilson* (BRI, CANB, NSW); S.F. 194, Mt Baldy, Herberton Range, 17°20′S, 145°24′E, Feb 2001, *Forster PIF26731* (A, BRI, HO, L, MEL, NSW, NY). North Kennedy District: Mt Stewart, E of Herberton, 17°23′S, 145°26′E, Jan 1998, *Jago 4650* (BRI, NSW); Near top of Mt Westminster Abbey [Lumholtz N.P.], 18°25′S, 146°02′E, May 1992, *Cumming 12014* (BRI); Frederick Peak, 25 km SW of Townsville, 19°24′S, 146°37′E, May 1991, *Bean 3207* (BRI); Mt Abbot, 50 km W of Bowen, 20°06′S, 147°46′E, Oct 1992, *Bean 5172* (BRI). South Kennedy District: Swampy Ridge, W of Eungella township, 21°05′S, 148°26′E, May 1992, *Bean 4462* (BRI). Leichhardt District: Bat Cave Gorge, Palmgrove N.P., Bigge Range, NW of Taroom, 24°53′S, 149°27′E, Sep 1999, *Forster PIF24711 & Booth* (BRI, MEL); Near Get Down, Robinson Gorge, Expedition N.P., 25°18′S, 149°10′E, Sep 1995, *Forster PIF17729 & Figg* (AD, BRI, MEL, NSW). Maranoa District: Spring Creek Gorge, Carnarvon Ranges, Oct 1933, *White 9492* (BRI). Port Curtis District: Rainbow Falls, Blackdown Tableland [N.P.], 23°51′S, 149°06′E, Jul 1992, *Bean 4661* (BRI, NSW); E escarpment of Kroombit Tops [N.P.], SW of Gladstone, 24°23′S, 151°02′E, *Bean 13130* (BRI); Dawes Range road, S.F. 67 Bulburin, E of Builyan, 24°35′S, 151°30′E, Mar 1995, *Bean 8420* (BRI). Burnett District: Cania Gorge N.P., near 'Dripping Rock', 24°43′S, 150°59′E, Nov 1993, *Bean 6961* (BRI); E Boogalgopal L.A., Coominglah S.F., W of Monto, 24°55′S, 150°56′E, Nov 1995, *Bean 9109 & Turpin* (BRI). Wide Bay District: Great Sandy N.P., Fraser Island, near Waddy Point Ranger Station, 24°57′S, 153°20′E, Sep 2004, *Forster PIF30279 & Leiper* (BRI); Mt Benarige, S.F. 57, St Mary, 25°41′S, 152°27′E, Jun 1993, *Forster PIF13391 & Machin* (BRI, CANB). Darling Downs District: Passchendale S.F., Aug 1983, *Harslett s.n.* (BRI [AQ 349640], CANB). Moreton District: Spicers Peak, W peak, Main Range N.P., 28°05′S, 152°23′E, Sep 1995, *Forster PIF17649 et al.* (BRI); Mt Huntley, summit area, Main Range N.P., 28°08′S, 152°25′E, Sep 1994, *Forster PIF15754 & Leiper* (AD, BRI, MEL, NSW); Main Range N.P., N of Mt Steamer, Lophostemon Knoll, 28°11′S, 152°26′E, Sep 1999, *Forster PIF24882 & Leiper* (BRI, MEL, NSW); Miller's property, Springbrook, 28°11′S, 153°15′E, Jan 2002, *Searle s.n.* (BRI [AQ 732953]); Near Patts Bluff, Lamington N.P., 28°13′S, 153°06′E, Mar 2000, *Bean 16132* (BRI, HO); Mt Gillies, 28°16′S, 152°45′E, Oct 1992, *Forster PIF12114 & Reilly* (BRI, MEL).

***Notes*:** Armstrong (1991a, 1991b, 2002) divided *Zieria smithii* into two subspecies, *viz.* subsp. *smithii* and subsp. *tomentosa*, on the basis of the density of the indumentum on the young branches, petioles and the abaxial surface of the leaflets. Armstrong & Harden (2002) indicated that the distinction between the subspecies is difficult to maintain and so did not describe them in their treatment of *Zieria* for the *Flora of New South Wales*. The distinction between these subspecies in Qld is also difficult to maintain and they are not recognised here despite the northern populations being distinctive in appearance.

In his description of *Zieria smithii*, Armstrong (2002) stated that the branches of the species are 'tuberculate (strongly so)' [the term verrucose is used here]. Most specimens seen for Qld have smooth branches unlike many specimens from NSW and Victoria. *Z. smithii* shows considerable variation over its range in the density of the indumentum on various organs, degree of verrucosity of the stems, petioles, leaflets and sepals, size of the leaflets, size and shape of the sepals etc.

Some plants from north-eastern Qld (*Forster PIF26731*) and Eungella N.P. (*Jones 11608*) tend to be slender with relatively small leaves. The density and extent of the stellate indumentum on the abaxial surface of the sepals is also highly variable in these plants: hairs may be confined to the base of the sepals, as with most plants from further south, or spread evenly over the entire surface. *Zieria smithii* subsp. *tomentosa* is based on plants from north-east Qld and the type is similar to these collections.

Plants from the Blackdown Tableland have glabrous stems that are slightly to strongly glandular verrucose. Similar plants are found on Kroombit Tops but sometimes these have stems with a sparse stellate indumentum. The near coastal sandy areas of south-eastern Qld (including the sand islands) have large-leaved plants with smooth stems that have a moderately dense stellate indumentum. Similar plants are found on the Springbrook and Lamington Plateaux but they usually have glabrous stems. Also on the Lamington Plateau and the 'Scenic Rim' are plants with slightly glandular verrucose leaves and sepals.

Detailed field and laboratory research is required to determine how many subspecific or additional specific taxa, if any, should be recognized for the populations referred here to *Zieria smithii*. These studies should include *Z. boolbunda* and Z. *robertsiorum*.

***Distribution and habitat*:** *Zieria smithii* is found in Victoria, NSW and Qld. In Qld it is found from the MacPherson Range and the 'Scenic Rim' north to near Atherton. It occurs in the Brigalow Belt, New England Tableland, Southeast Queensland and Wet Tropics bioregions. It occurs in a variety of communities including rainforest, rainforest-sclerophyll ecotones, in open woodland or forest dominated by *Eucalyptus*, *Corymbia*, *Syncarpia* etc., including on occasion, *Agathis*, and in heath and swampy areas. It is also found in rocky areas in rainforests, along creeks, in gorge country and along cliff lines etc. It has been collected on a wide variety of substrates including granite, sandstone, sand and trachyte.

***Phenology*:** Flowers and fruits mainly between January and September though fertile collections have been made in all other months.

***Conservation status*:** The species is common and widespread with many populations in National Parks. An appropriate conservation status is **Least Concern** (IUCN 2001).

31. Zieria southwellii J.A.Armstr., *Austral. Syst. Bot.* 15: 443 (2002). **Type:** New South Wales. North Coast: Dorrigo Plateau, Mt Moombil, 6 km SE of Megan, 30°19′S, 152°52′E, 10 September 1988, *I.R.Telford 10705* (holo: CANB [CBG 8802857]; iso [as per Armstrong (2002)]: BRI, HO *n.v.* [specimen has not been located], NSW *n.v.*, PERTH *n.v.*).

Zieria sp. (Lamington G.Leiper AQ502702); Forster (1997b: 188; 2002: 181).

***Illustrations*:** Armstrong (2002: 444, 445); Logan River Branch SGAP (QLD Region) Inc. (2005: 364).

***Additional specimens examined*:** **Queensland.** Moreton District: Wagawn, Aug 1959, *Blake 20603* (BRI, CANB); 1.2 km along Carrick road, Springbrook, 28°11′S, 153°16′E, Oct 1997, *Bean 12495* (BRI); Boyull Creek, Springbrook, 28°13′S, 153°16′E, Sep 1993, *Forster PIF13881 & Leiper* (BRI, CANB); Wagawn, Lamington N.P., 28°15′S, 153°13′E, Apr 1994, *Forster PIF15120 & Leiper* (BRI, K, MEL, NSW); Near Orchid Grotto, Lamington N.P., 28°14′S, 153°08′E, Aug 1994, *Forster PIF15672 & Leiper* (BRI); *loc. cit.*, Oct 1991, *Ross 3438* (HO, MEL); Coomera Circuit, Lamington N.P., 28°14′S, 153°11′E, Jan 1995, *Forster PIF16063 & Leiper* (BRI, MEL, NSW); Junimbabah Lookout, Lamington N.P., Nov 1990, *Leiper s.n.* (BRI [AQ502702]); Lamington Plateau, Moonlight Crag, near O'Reilly's Guest House, 28°16′S, 153°09′E, May 1994, *Leiper s.n.* (BRI [AQ627912]); Coomera Circuit, N of Coomera Falls, Lamington N.P., Oct 1994, *McDonald 6161* (BRI); Lamington N.P., Beechmont, Jun 1957, *Wilson 697* (BRI). **New South Wales.** Along road to Mt Nardi, NE of Nimbin, 28°33′S, 153°18′E, Oct 1994, *Bean 7958* (BRI, MEL, NSW); Peates Mt road, Whian Whian S.F., N of Lismore, 28°35′S, 153°22′E, Sep 1994, *Bean 7920* (BRI); T-junction, 1.2 km N of Lowanna, W of Coffs Harbour, 30°12′S, 152°53′E, Sep 2000, *Bean 16876* (BRI, NSW); Dibbs Head, Dorrigo N.P., 30°22′S, 152°49′E, May 1994, *Bean 7712* (BRI, NSW); Whian Whian S.F., Gibbergunyah road, *c.* 30 km N Lismore, Nov 1992, *Read s.n.* (BRI [AQ580930], NE *n.v.*).

***Distribution and habitat*:** *Zieria southwellii* is found in the extreme south-east corner of the Southeast Queensland bioregion and in north-eastern NSW to as far south as Dorrigo N.P. In Qld, *Z. southwellii* is found in the Springbrook area and in Lamington N.P. (**Map 2**). Plants grow either in tall open eucalypt forest on rhyolitic or metamorphic substrates with canopy species that may include *Eucalyptus acmenoides*, *E. campanulata*, *E. grandis*, *E. microcorys*, *E. oreades*, *E. saligna* and *Lophostemon confertus* and midstorey species that include *Allocasuarina torulosa* and *Acacia orites,* or in simple moss-fern thicket on basalt substrates, with a very open canopy.

***Phenology*:** Flowers have been collected from August to December, and fruit in August.

***Conservation status*:** Armstrong (2002) considered that the "conservation status of this species cannot be reliably determined until more information is available". *Zieria southwellii* is common and widespread throughout its range, with large populations in National Parks at Dorrigo and Mt Warning in NSW, and Lamington in Qld. An appropriate conservation status is **Least Concern** (IUCN 2001).

32. Zieria tenuis Duretto & P.I.Forst. **species nova** a *Z. collina* C.T.White calycis lobis angusti-triangularis triangularibus (in illa late ovatis), petalis elliptico-ovatis et majoribus (2–2.5 mm longitudine) (in illa ovata ovatis et minoribus longitudine 1.2–2 mm) et coccis praeditis appendice apicali (adversus appendicem deficientem); et a *Z. cytisoides* Sm. foliolis angusti-ellipticis usque oblongis (adversum foliola elliptica usque obovata) ratione longitudinis latitudini 3.7–6 (adversum 1.8–3.3), indumento stellato-tomentoso coarcte in folii pagina inferiore (in illa hirta usque ad 1 mm longa longitudine) et venatione obscure obscura laterali in pagina abaxiali foliolorum (adversum venationem manifeste elevatam) differt. **Typus:** Queensland. Cook District: Agate Creek, Robinhood Station, SW of Forsayth, 18°50′S, 143°25′E, *P.I.Forster PIF19086, R.L.Jago, R.Jensen & T.Ryan*, 20 April 1996 (holo: BRI; iso: MEL 242485).

Zieria sp. (White Mt D.G.Fell+ DGF1257); Forster (2002: 181; 2007: 183).

Shrub to 1.5 m tall, forming an open straggly bush. Stems ± erect, wiry; branches without obvious decurrent leaf bases, weakly glandular verrucose, densely stellate-tomentose. Leaves palmately trifoliolate; petioles 5–18 mm long, sometimes weakly glandular verrucose, stellate tomentose; terminal leaflets oblong to narrow-elliptic, 9–32 × 2.5–7 mm, laminae not obviously glandular, tips obtuse, slightly mucronate, margins smooth, midribs raised abaxially, secondary veins slightly raised, adaxial surfaces with a sparse to dense cover of minute stellate-tomentose hairs, abaxial surfaces densely stellate-tomentose; lateral leaflets similar to terminal leaflets but smaller, 4–22 × 2–7 mm. Inflorescence axillary, shorter than the subtending leaf, 9–12-flowered, not obviously glandular, densely stellate-tomentose; peduncle 8–18 mm long; bracts linear-lanceolate, persistent, 1–3.2 mm long; secondary peduncles 3–4 mm long; pedicels 1–2.2 mm long. Sepals narrow-triangular, 1–2.5 × 0.7–1 mm, valvate in bud, not obviously glandular, tips acute to slightly acuminate, both surfaces stellate-tomentose. Petals elliptic-ovate, 2–2.5 × 0.9–1.5 mm, white or pink-white, valvate in bud, not obviously glandular, adaxial surfaces glabrous to glabrescent or with hairs along margins, abaxial surfaces with a moderately dense stellate indumentum. Staminal filaments *c.* 1 mm long, glabrous and eglandular; anthers *c.* 0.4 mm long, apiculum absent. Gynoecium glabrous. Cocci 2.5–3.5 × 1.5–1.8 mm, pellucid gland-dotted, glabrous, base of style persistent forming a minute apical apiculum. Seeds ovoid, 1.8–2.2 × 0.8–1 mm, black to dark brown, weakly longitudinally striate. **Fig. 15.**

***Additional specimens examined*: Queensland.** Cook District: Side gorge off Agate Creek, 18°50′S, 143°25′E, Apr 1996, *Jago 3968 & Forster* (BRI). Burke District: White Mountains [N.P.], N of Hughenden, 20°19′S, 144°49′E, Aug 1984, *Godwin C2722* (BRI); Junction of Rugged Gorge & side branch *c.* 6 km upstream from junction with Flinders River, White Mountains [N.P.], *c.* 60 km N of Torrens Creek, 20°23′S, 144°47′E, Apr 2000, *Thomas 1640 & Thompson* (BRI, DNA); White Mountains N.P., NW of Warang, 20°24′S, 144°47′E, Apr 2000, *Wannan 1702 & Martindell* (BRI, CANB, NSW); Branch of Warang Gorge, White Mountains N.P., 20°24′S, 144°48′E, Sep 1992, *Bean 5013* (BRI); White Mountains N.P., 1 km N of old Warang Homestead, 20°26′S, 144°49′E, 1998, *Johnson 2* (BRI); Bertya Creek, W of 'Warang', White Mountains N.P., 20°27′S, 144°46′E, Jun 1992, *Bean 4609* (AD, BRI, K, MEL, NSW, PERTH *n.v.*); Warang, White Mountains [N.P.], 37 km NNW of Torrens Creek, 20°29′S, 144°48′E, Jul 1988, *Fell DF1257* (BRI). North Kennedy District: Torrens Creek Gorge, White Mountains [N.P.], 20°26′S, 144°49′E, Jul 1991, *Cumming 11251* (BRI). Mitchell District: 41 km NW of Torrens Creek, 20°26′S, 144°50′E, Apr 1993, *Thompson HUG416 et al.* (BRI, NSW).

***Notes*:** *Zieria tenuis* appears to be allied to *Z. collina* and *Z. cytisoides*. It is remarkably similar on first appearances to *Z. collina*, a restricted species that is endemic to the Tamborine Mountain area of south-east Qld. *Z. collina* differs from *Z. tenuis* in the smaller, ovate petals that are 1.2–2 mm long (not 3.5 mm long as stated in Armstrong 2002) (versus larger elliptic-ovate petals that are 2–2.5 mm long), the broadly ovate calyx lobes (versus narrow-triangular), the cocci lacking an appendage (versus with an apical appendage) and being smaller (*c.* 2 mm long, versus 2.5–3.5 mm long). *Z. tenuis* differs from *Z. cytisoides* in the lateral venation in the leaflets being indistinct on the abaxial surface (versus prominently raised), the leaflets being narrow-elliptic to oblong (versus elliptic to obovate) with a length/width ratio of 3.7–6 (versus 1.8–3.3), the close stellate tomentose

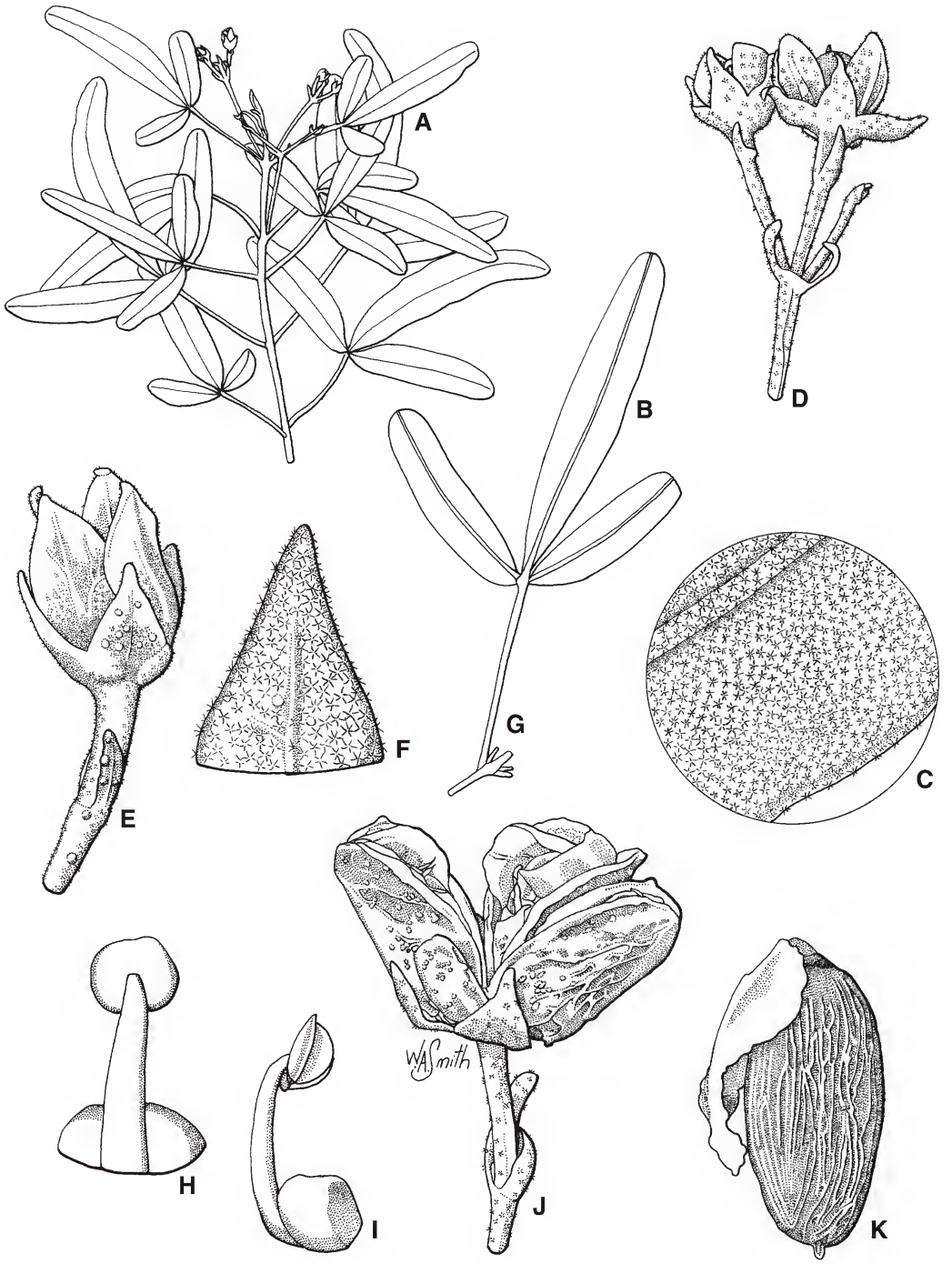

Fig. 15. ***Zieria tenuis.*** A. branch with several flowering inflorescences × 1. B. stem node with abaxial view of leaf × 2. C. detail on indumentum on abaxial surface of leaflet × 16. D. inflorescence with flowers × 6. E. flower × 8. F. tip of abaxial side of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. J. lateral view of seed × 16. A–D from *Forster PIF19086* (BRI); E–J from *Thomas 1640* (BRI). Del. W. Smith.

indumentum less than 0.2 mm long (versus a shaggy indumentum to 1 mm long), and smaller petals (2–2.5 mm long versus 3.6–6 mm long).

Some of the collections of *Zieria tenuis* from the White Mountains area have a less dense indumentum on the adaxial surface of the leaflets and one collection from Bertya Creek (*Bean 4609*) has smaller floral and vegetative parts than other specimens.

***Distribution and habitat*:** *Zieria tenuis* is endemic to Qld within the Desert Uplands and Einasleigh Uplands bioregions where it is known from two widely disjunct areas: Agate Creek near Forsayth and the White Mountains, north of Torrens Creek (**Map 2**). The species is found growing on sandstone derived substrates in gorges or on alluvium under eucalypt woodland that includes the canopy species *Corymbia citriodora*, *C. leichhardtii*, *C. trachyphloia*, *Eucalyptus mediocris*, *Lophostemon grandiflorus* and *L. suaveolens*.

***Phenology*:** Flowers and fruit have been collected from April to July.

***Conservation status*:** There are numerous populations of *Zieria tenuis* protected within the White Mountains N.P. and the population on Robinhood Station is also secure for now. An appropriate conservation status is **Least Concern** (IUCN 2001).

***Etymology*:** The specific epithet is derived from the Latin *tenuis*, and refers to the delicate inflorescence of the species (peduncles up to 18 mm long and only *c.* 0.5 mm wide).

33. Zieria vagans Duretto & P.I.Forst., **species nova** a *Z. verrucosa* J.A.Armstr. foliis patentibus vel erectis (in illa cernuis), foliolis anguste ellipticis (adversum linearia) ratione longitudinis latitudini 7.5–10.8 (adversus 10–25.3), supra non manifeste glandularibus (in illa valde glandulari-verrucosis) et sepalis non manifeste glandularibus (in illa dispersis glandularibus) differt. **Typus:** Queensland. Burnett District: Fontainea Scrub, Gurgeena Plateau, State Forest 172, 25°26′S, 151°23′E, 9 February 1994, *P.I.Forster PIF14801* (holo: BRI; iso: A, MEL 306447, MO, NSW).

Zieria sp. (Binjour P.I.Forster PIF14134); Forster (1997b: 188; 2002: 181; 2007: 183).

Shrub to 2 m tall, forming an open, straggly bush. Stems erect to weakly decumbent; young branches without decurrent leaf bases, markedly glandular verrucose, densely stellate-tomentose. Leaves palmately trifoliolate; petioles 5–13 mm long, glandular verrucose, densely stellate-tomentose; terminal leaflets narrowly elliptic, 32–45 × 3.5–5.5 mm, tips obtuse, margins smooth to glandular dentate, midribs and some secondary veins raised abaxially, midribs glandular verrucose, adaxial surfaces not obviously glandular (apart from being pellucid gland dotted), glabrous or with a sparse indumentum of simple and/or stellate hairs, abaxial surfaces glandular verrucose, densely stellate-tomentose; lateral leaflets similar to terminal leaflets but usually smaller, 23–36 × 3.5–4.5 mm. Inflorescence axillary, shorter than the subtending leaf, 3–15-flowered, glandular verrucose, densely stellate-tomentose apart from pedicels; peduncle 5–13 mm long; bracts narrow-oblong, persistent, 1–6 mm long; secondary peduncles 1–4 mm long; pedicels 2–4 mm long, with a sparse stellate indumentum. Sepals deltate, 0.8–1 × 0.8–1 mm, valvate in bud, not obviously glandular, tips acute, adaxial surfaces glabrous apart from puberulous margins, abaxial surfaces with a sparse to dense stellate and simple indumentum that becomes denser along margins. Petals elliptic, *c.* 2 × 1.2–1.3 mm, cream-white, valvate in bud, not obviously glandular, adaxial surfaces minutely pilose, abaxial surfaces with a moderately dense simple and stellate indumentum. Staminal filaments 0.8–1 mm long, glabrous or glabrescent with simple or stellate hairs, weakly glandular verrucose distally; anthers *c.* 0.4 mm long, apiculum absent. Gynoecium glabrous. Cocci 2.5–4.5 × 1.6–2.2 mm, smooth, glabrous, base of style not persistent. Seeds ovoid, 2–2.2 × 1–1.4 mm, grey-black to black-purple, dull, faintly longitudinally striated. **Fig. 16.**

***Additional specimens examined*: Queensland.** Burnett District: S.F. on Binjour Plateau, Oct 1987, *Bean 671* (BRI); S.F. 172, Binjour Plateau, Sep 1989, *Forster PIF5730 & Bean* (BRI); Binjour Plateau, S.F. 172, near Meredith's road, Oct 1993, *Forster PIF14134* (A, AD,

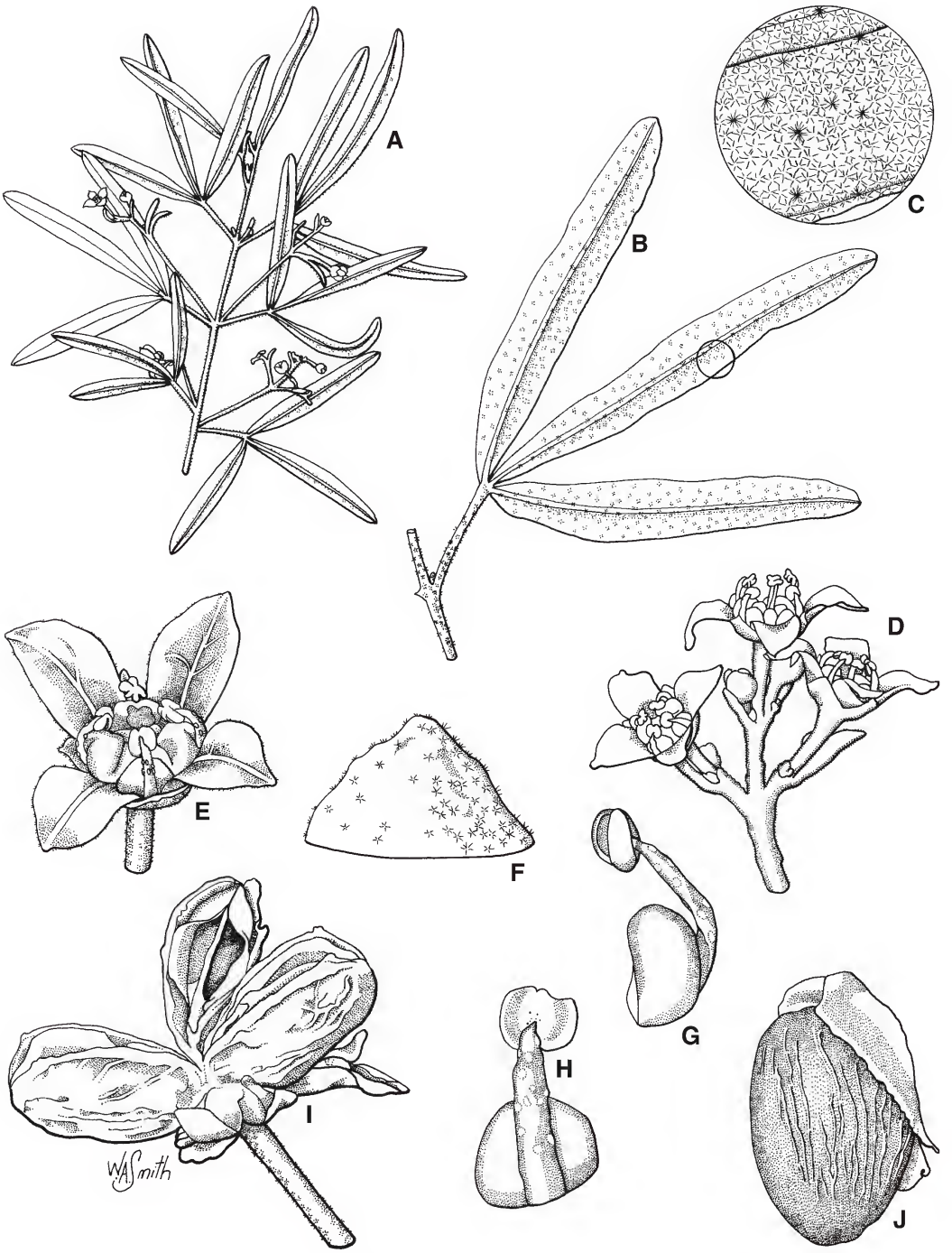

Fig. 16. ***Zieria vagans.*** A. branch with several flowering inflorescences × 1. B. node with abaxial view of leaf × 2. C. detail of indumentum on abaxial surface of leaflet × 16. D. inflorescence with buds & flowers × 4. E. flower × 8. F. tip of abaxial side of sepal × 20. G–H. views of stamens × 20. I. mature fruit with multiple cocci × 8. J. lateral view of seed × 16. A–C, I–J from *Forster PIF15065* (BRI); D–H from *Forster PIF14801* (BRI). Del. W. Smith.

BRI, DNA, L, MEL, MO, NSW, NY); Fontainea Scrub, S.F. 172, Gurgeena Plateau, Mar 1994, *Forster PIF15065* (A, BRI, L, MEL, NE); Orchid Scrub, Gurgeena Plateau, S.F. 172, Dec 1996, *Forster PIF20122* (BRI, MEL).

***Notes*:** As noted under *Zieria distans*, together with *Z. verrucosa,* this species forms part of a threesome of closely related taxa. *Z. vagans* differs from *Z. verrucosa* in the leaves that are held patently or erect (versus drooping), the leaflets that are narrow-elliptic (versus linear) with a length/width ratio of 7.5–10.8 (versus 10–25.3) and that are not obviously glandular above (versus strongly glandular verrucose) and the not obviously glandular sepals (versus scattered glandular verrucose). Both *Z. vagans* and *Z. verrucosa* share similar sized leaves and narrow-oblong bracts on the inflorescences. Differences between *Z. distans* and *Z. vagans* are outlined in the notes under the former.

***Distribution and habitat*:** *Zieria vagans* is endemic to Qld within the Brigalow Belt bioregion and is confined to the central Burnett district where all collections have been made on the Gurgeena Plateau near Binjour (**Map 2**). The Gurgeena Plateau is a relictual plateau with a lateritised duricrust. On the Gurgeena Plateau this species occurs as an understorey component in semi-evergreen vinethicket dominated by *Backhousia kingii* on red soils or in the ecotone between this community and adjacent eucalypt woodland.

***Phenology*:** Flowers have been collected from October to March, and fruit from December to March.

***Conservation status*:** On the Gurgeena Plateau there appear to be only two populations of *Zieria vagans*, both within S.F. 172. The population near Meredith's Road in S.F. 172 co-occurs with another endangered species, *Fontainea fugax* P.I.Forst. Direct threats to these populations include grazing from stock and fire. At the Meredith's Road site, there are the beginnings of infestations by environmental weeds such as *Aristolochia elegans* (Dutchman's pipe). *Z. vagans* has a total area of occupancy of less than 5 ha. This species is listed as **Endangered** in Qld (*NCR* 2006) and fulfils the IUCN criteria of A1(c), B2a, c(iv), C2b. (IUCN 2001).

***Etymology*:** The specific epithet is derived from the Latin *vagans* (wandering, unsettled) and alludes to the existence of some populations of this species on the fire prone ecotone between eucalypt woodland and semi-evergreen vinethicket.

34. Zieria verrucosa J.A.Armstr., *Austral. Syst. Bot.* 15: 456 (2002). **Type:** Queensland. Burnett District: West of Proston, July 1949, *L.J.Webb 5068* (holo: BRI; iso: BRI).

Zieria sp. 1; Ross (1983: 442).

Zieria sp. (Monogorilby P.I. Forster PIF1004); Forster (1997b: 188; 2002: 181).

***Illustrations*:** Armstrong (2002: 454, 455).

***Addition to description given by Armstrong (2002)*:** Cocci 2.5–3.5 × 1.8–2.2 mm, smooth, with apiculate tip and weakly longitudinally striate. Seeds ovoid, 1.9–2 × 1.1–1.2 wide, black to dark brown, shiny, longitudinally striated.

***Additional specimens examined*: Queensland.** Burnett District: Narayen Research Station, Mundubbera, 25°35′S, 151°17′E, Oct 1977, *Hargraves s.n.* (CANB); 'Narayen', *c.* 30 miles [50 km] W of Mundubbera, 25°36′S, 150°50′E, Dec 1967, *Tothill N418* (BRI); 'Narayen', Dec 1967, *McHarg N418* (BRI); 3.5 km NNE of Monogorilby, 26°02′S, 151°00′E, Sep 1994, *Forster PIF15823* (BRI, MEL, NSW); 3.5 km N of Monogorilby, 26°02′S, 151°01′E, Dec 1981, *Forster PIF1004* (BRI, CANB, NSW); 3 km N of Monogorilby, 26°02′S, 151°01′E, Aug 1989, *Forster PIF5646* (BRI, CANB, DNA, MEL); Speedwell, N of Proston, 26°02′S, 151°32′E, Mar 1997, *Bean 11807* (BRI, MEL); Stalworth road, north of Proston, 26°07′S, 151°36′E, Sep 1996, *Bean 10672* (BRI); *loc. cit.*, Nov 1996, *Bean 11360* (BRI, MEL); Abbeywood, Abbeywood road, 2 km S of Proston, 26°07′S, 151°37′E, Jun 1994, *Thomas 329 & Sinclair* (BRI); 2 km S of Abbeywood, on Proston road, 26°08′S, 151°37′E, Aug 1989, *Forster PIF5655* (BRI, CANB, MEL); Reinke's Scrub, 1.5 km SW of Proston, 26°10′S, 151°35′E, Aug 1991, *Forster PIF9096* (AD, BRI, L, MEL, MO, NSW, NY); 2.5 km from Proston, on road to weir, 26°10′S, 151°35′E, May 1996, *Bean 10284* (BRI); Proston Town Reserve, Aug 1989, 26°10′S, 151°36′E, Aug 1989, *Forster PIF5656* (BRI, MEL); Nanango area, 26°45′S, 152°05′E, Feb 2002, *Fox s.n.* (BRI [AQ553293]).

***Typification*:** There appears to be slight confusion in citation of some collections for this species by Armstrong (2002). As type he gives *L.J.Webb 5068* from 'West of Proston', then in the '*Specimens examined*' he cites the collection twice, once with this locality,

and the second with 'Monogorilby, W of Proston'. Certainly, this is how the two sheets of *Webb 5068* are labelled, but it is unlikely that they represent different localities. It is perhaps most likely that the type collection was actually from Monogorilby as Webb visited there for the purposes of vegetation survey, although as the species is known to occur at both Monogorilby and Proston, the origin of the specimen cannot be accurately determined.

***Notes*:** Many more specimens are now available of this species than were cited or examined by Armstrong (1991a, 2002) and it is possible to provide fruit and seed descriptions as given above.

***Distribution and habitat*:** *Zieria verrucosa* is endemic to Qld within the Brigalow Belt and Southeast Queensland bioregions with populations centred near Abbeywood, Proston, Monogorilby, 'Narayen' and Nanango (**Map 4**). This species usually occurs in semi-evergreen vinethicket on red krasnozem soil. At Nanango it is in *Eucalyptus crebra* woodland on red clay soil. The plants are often abundant in open areas of the understorey and more so where the vegetation has been disturbed or has regrown after clearing.

***Phenology*:** Flowers and fruit have been collected from August to February.

***Conservation status*:** This species is listed as **Vulnerable** in Qld (*NCR* 2006). The species distribution is now reliably determined (*cf.* Armstrong 2002) and this coding is appropriate for the species, although it may require upgrading to Endangered. Major threats to the species continue to be land clearing for agricultural and destruction of populations on roadsides or in regrowth on private freehold land. No populations occur in conservation reserves and the only population that is probably reasonably secure is the small one on 'Narayen'. The population at Proston in the town reserve is badly degraded with extensive damage and weed infestation. The populations at Monogorilby, Stalworth Road, Speedwell and near Abbeywood are all on roadsides, or on private freehold land (usually in regrowth) and have no real protection in areas that are intensively cultivated or maintained for cattle grazing.

35. Zieria whitei J.A.Armstr. ex Duretto & P.I.Forst., **nom. et stat. nov.**; *Zieria aspalathoides* var. *intermedia* C.T.White, *Proc. Roy. Soc. Queensland* 53: 209 (1942). **Type:** Queensland. North Kennedy District: Ravenshoe, June 1913, *E.W.Bick 116* (holo: BRI [AQ520881 – 2 sheets]).

Zieria sp. (Ravenshoe E.W.Bick 116); Forster (1997b: 188).

Shrub to 50 cm tall, forming a densely compact bush. Stems erect, wiry; branches without or with slightly decurrent leaf bases, not glandular verrucose, pubescent with mainly stellate hairs but also with simple, bifid and a few trifid hairs. Leaves palmately trifoliolate (though first pair of leaves on secondary shoots simple and up to 4 mm wide), not glandular verrucose; petioles 0.5–1 mm long, stellate pubescent; terminal leaflets narrow elliptic to narrow oblanceolate, 5–10 × 1–2.5(3) mm, tips acute, margins mostly recurved to revolute, sometimes flat, midribs raised abaxially, secondary veins obscure, adaxial surfaces sparsely pilose to pilose with simple and bifid hairs, sometimes hairs confined to midribs, abaxial surfaces with a moderately dense indumentum of stellate hairs with a few simple hairs; lateral leaflets similar to terminal leaflets. Inflorescence axillary, longer than the subtending leaf, usually 3-flowered, not glandular verrucose, with a moderately dense stellate indumentum; peduncle 3–14 mm long; bracts narrow-elliptic to narrow-lanceolate, persistent, 1–2 mm long; pedicels 2–3 mm long. Sepals ovate-deltate, 1.5–2 × 0.7–2 mm, valvate in bud, slightly glandular verrucose, tips acute, adaxial surfaces with scattered simple and bifid appressed hairs, abaxial surfaces glabrescent or with a dense indumentum of stellate hairs. Petals elliptic, 2.5–3 × *c.* 1.5 mm, white to pale pink, valvate in bud, not obviously glandular, adaxial surfaces glabrescent, abaxial surfaces with a dense indumentum of stellate hairs. Staminal filaments *c.* 1.2 mm long, glabrescent, slightly glandular verrucose at apex; anthers *c.* 0.6 mm long, apiculum minute. Ovary glabrous or with a stellate indumentum; style glabrous. Cocci *c.* 3.5 × 2 mm, smooth to slightly glandular verrucose, glabrous or with scattered stellate hairs. Seeds not observed. **Fig. 17.**

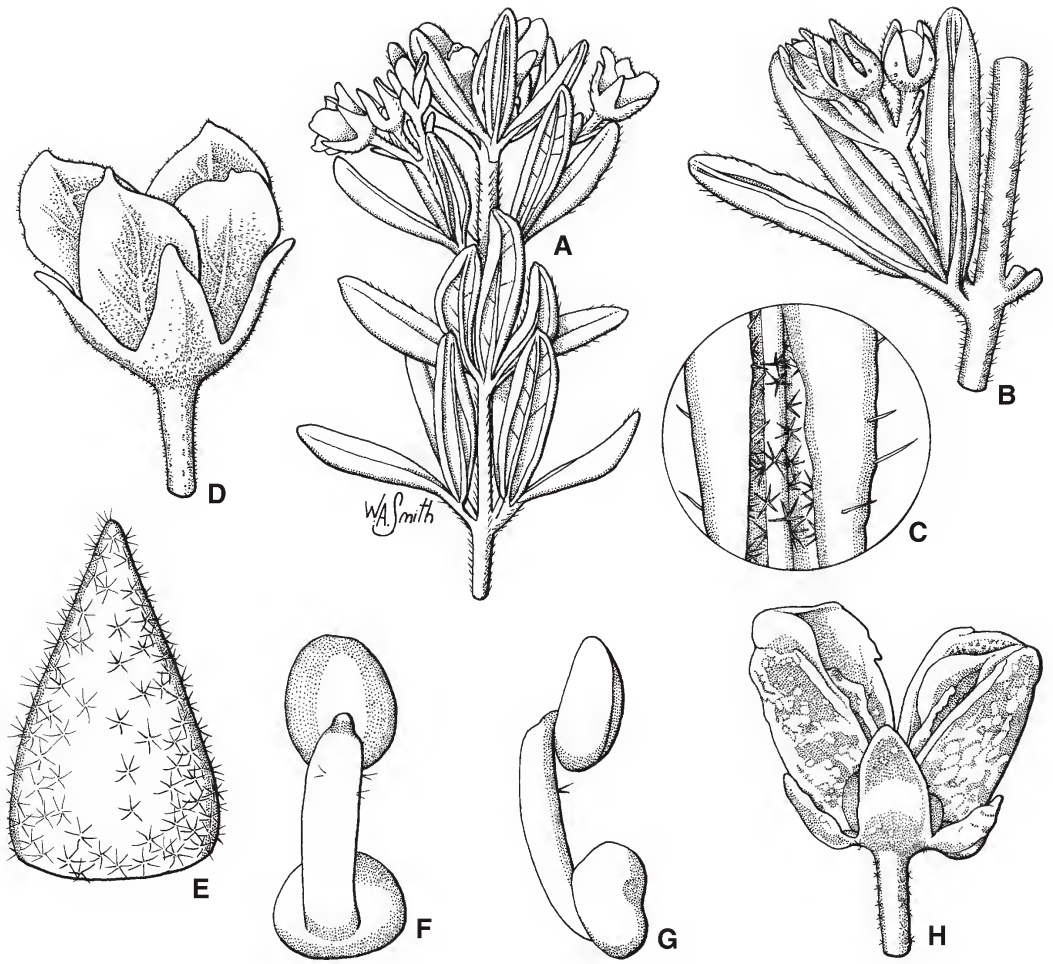

Fig. 17. ***Zieria whitei.*** A. branch with several flowering inflorescences × 2. B. node with abaxial view of leaf and single inflorescence with bud and flower × 4. C. detail of indumentum on abaxial surface of leaflet × 16. D. flower × 8. E. tip of abaxial side of sepal × 20. F–G. views of stamens × 20. I. mature fruit with multiple cocci × 8. A–G from *Forster PIF30695* (BRI); H from *McDonald KRM2964* (BRI). Del. W. Smith.

***Additional specimens examined*: Queensland.** Cook District: Near Mt Emerald, SW of Walkamin, 17°11′S, 145°22′E, Jul 1998, *Bean 13750* (BRI); near boundary of Mt Baldy S.F., Western L.A., 17°16′S, 145°21′E, Jul 2004, *McDonald KRM2964 & Bean* (BRI). North Kennedy District: Headwaters Archer Creek, *c.* 3 miles [*c.* 5 km] WNW of Ravenshoe, Jul 1978, *Lockyer 3* (NSW); Bald Rock, *c.* 1.3 miles [*c.* 2 km] WSW of Ravenshoe, May 1975, *Lockyer 67* (NSW); Bald Rock, eastern slopes, S.F. 511, W of Ravenshoe, 17°36′S, 145°27′E, Jul 2004, *McDonald KRM2969* (BRI); S.F. 511, Bald Rock, near Ravenshoe, 17°36′S, 145°27′E, Apr 2005, *Forster PIF30695 & McDonald* (BRI, HO); S.F.R. 488, 2.5 km S of Ravenshoe, off Wooroora road, 17°38′S, 145°29′E, May 2001, *Ford AF2808 et al.* (BRI, MEL).

***Notes*:** White (1942) named a number of new taxa in *Zieria*, including this one as a variety of *Z. aspalathoides*. At the same time he also named *Z. aspalathoides* var. *obovatum* C.T.White, subsequently recognised as *Z. obovata* by Armstrong (2002). *Z. aspalathoides* var. *intermedia* was omitted from the monograph by Armstrong (2002), although he indicated in a footnote on p. 277 that this was a new species. He also annotated the type specimen (this comprises two individuals on two sheets) at BRI in 1992 with the name *Z. whitei* J.A.Armstr. ms. and labels that said 'Lectotype' and 'Isolectotype' respectively. White (1942) quite clearly states that the type collection for his new variety was *E.W.Bick 116*. Although two individual

pieces are represented in the collection, we consider them to be part of the same gathering and so do not consider that lectotypification of the name is necessary.

Zieria whitei is clearly allied to *Z. aspalathoides* but differs from that species in having a stellate indumentum on the stems, abaxial surface of the leaves and the abaxial surface of the sepals.

***Distribution and habitat*:** *Zieria whitei* is endemic to Qld within the Einasleigh Uplands bioregion and is known from several populations near Atherton and Ravenshoe (**Map 3**). It has been collected in rocky situations (rhyolite) in tall heathy shrubland or woodland with *Corymbia abergiana*, *Eucalyptus lockyeri*, *E. pachycalyx*, *E. reducta* and *Syncarpia glomulifera* common as overstorey dominants, and associated species including *Allocasuarina torulosa*, *Borya nitida*, *Homoranthus porteri*, *Leptospermum amboinense*, *Prostanthera clotteniana*, *Pseudanthus pimeleoides* and *Persoonia tropica*.

***Phenology*:** Flowers have been collected from May to July, and fruits in June.

***Conservation status*:** The habitat of *Zieria whitei* is poorly known and because of its inconspicuous nature may be undercollected, rather than actually rare. Five populations are currently known and there are no records from conservation reserves at this stage. A conservation status of **Vulnerable** based on the criteria B2a,b(i-v), D2 (IUCN 2001) is appropriate. Surveys are required to determine the number of populations, number of individuals and an area of occupancy. It co-occurs with the Endangered *Prostranthera clotteniana* at one locality.

***Etymology*:** This epithet was coined by Armstrong to honour C.T. White (1890–1950) past Government Botanist of Queensland who named a number of new taxa of *Zieria*.

Acknowledgements

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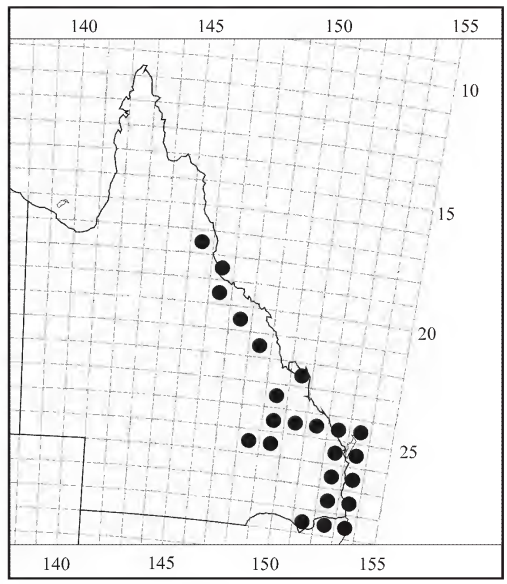
Distribution of *Zieria* species in 1° grid squares within Queensland.



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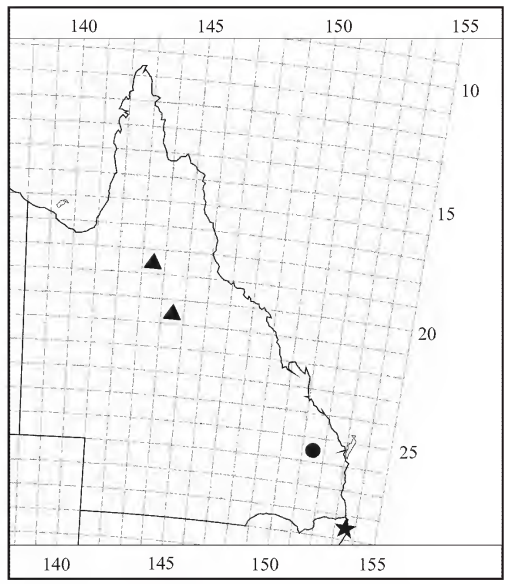

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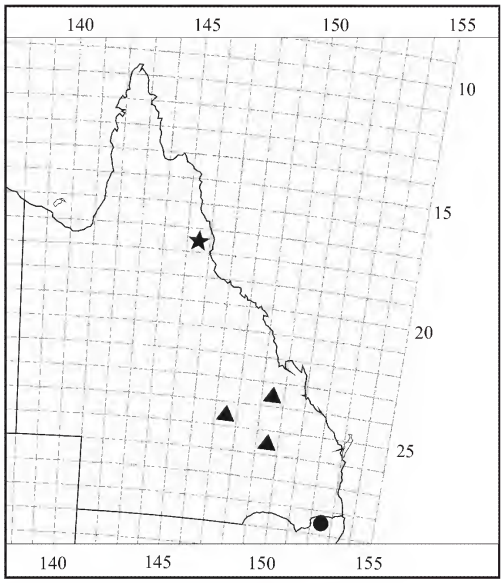

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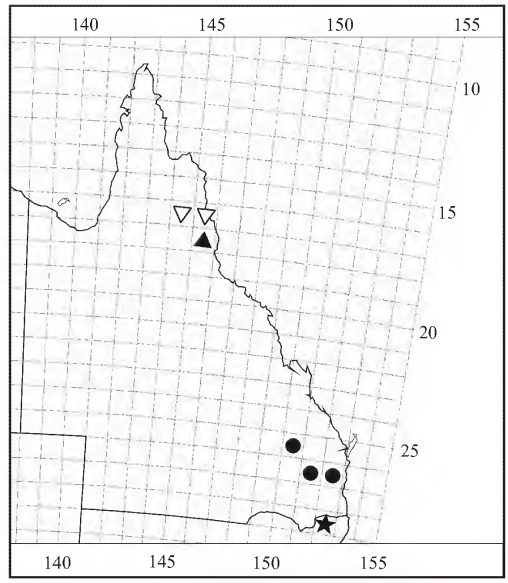

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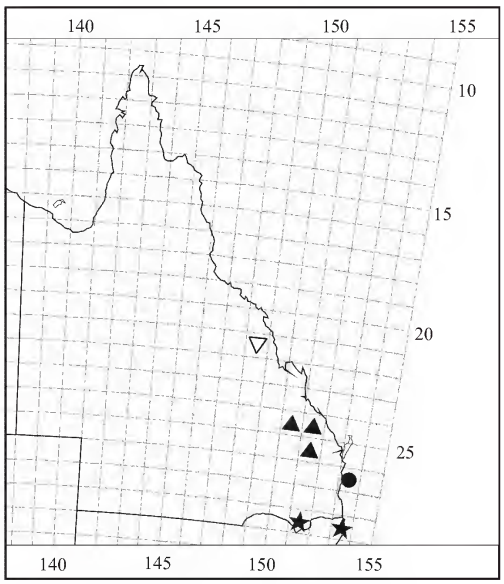

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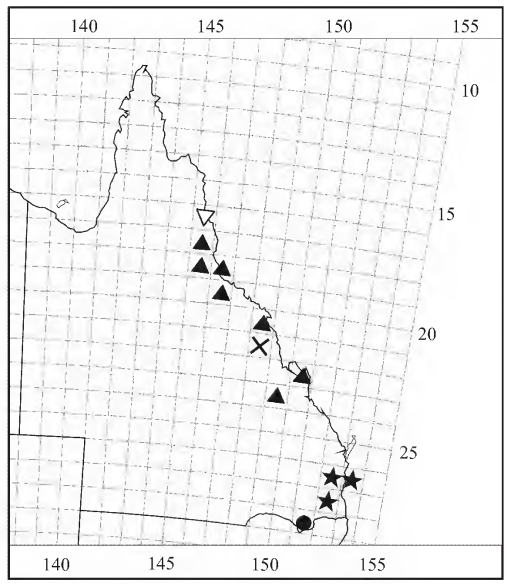

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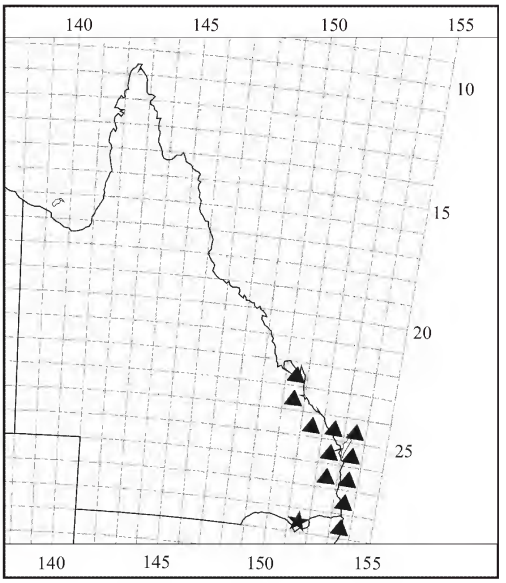

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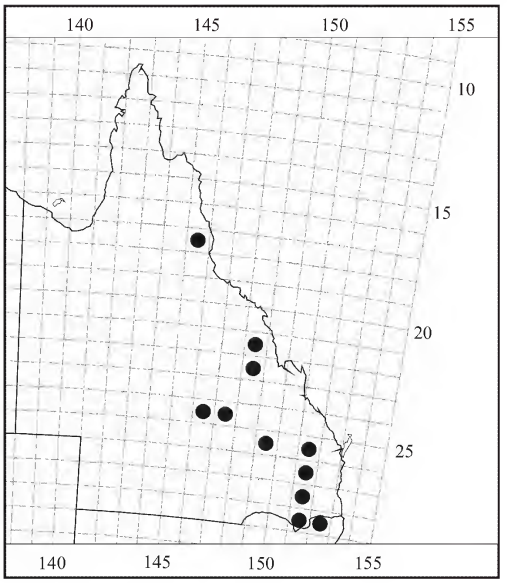

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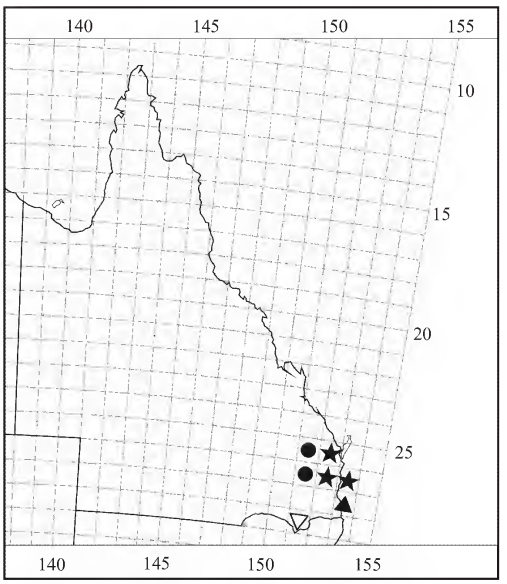

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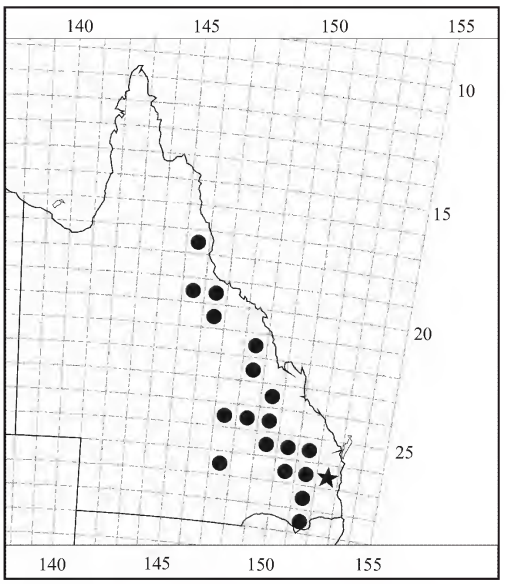

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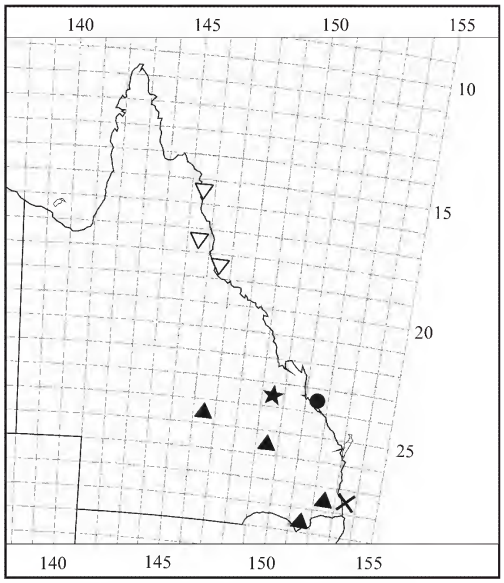

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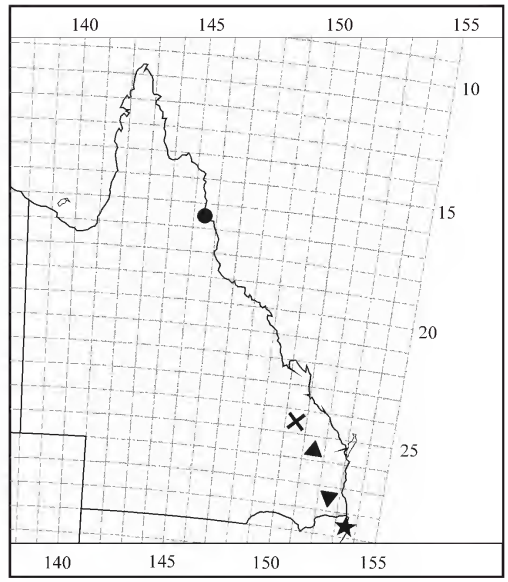

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A taxonomic revision of *Callitriche* L. (Callitrichaceae) in Australia

A.R.Bean

Summary

Bean, A.R. (2007). A taxonomic revision of *Callitriche* L. (Callitrichaceae) in Australia. *Austrobaileya* 7(3): 545–554. A morphological taxonomic study of *Callitriche* L. occurring in Australia (excluding island territories) has resulted in a reduction in the number of accepted indigenous species, with two species being reduced to synonymy (*C. cyclocarpa* Hegelm. under *C. umbonata* Hegelm.; *C. capricorni* R.Mason under *C. sonderi* Hegelm.). The name *Callitriche hamulata* has been misapplied in Australia for *C. brutia* Petagna var. *brutia*. Lectotypes are chosen for *Callitriche brachycarpa* Hegelm., *C. umbonata* Hegelm. and *C. muelleri* Sond. *Callitriche deflexa* A.Braun ex Hegelm. is a recent naturalisation for Australia. All names used for Australian *Callitriche* have been accounted for. A key is provided for the identification of *Callitriche* species occurring in Australia.

Key Words: Callitrichaceae, *Callitriche*, Australia, Australian flora, taxonomy, nomenclature, typification, identification key

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Introduction

Callitriche L. is a genus of about 75 species, found throughout temperate to subtropical parts of the world, mostly in the northern hemisphere. They are delicate herbs, often aquatic or amphibious, sometimes terrestrial, but then always in close proximity to water. The leaves are always opposite, but submerged leaves may differ greatly from emergent ones. All species occurring in Australia are monoecious, with the flowers consisting only of a stamen or a pair of carpels. The fruits comprise four (often winged) mericarps, in two pairs. Their size and shape are often diagnostic for species identification.

Bentham (1864) recorded only one species of *Callitriche* (*C. verna* L.) for Australia. Although taxonomic papers by C.F.Hegelmaier in 1864, 1867 and 1869 resulted in several new species described for Australia, these species were not recognised by Australian botanists until the revision of Mason (1959). Mason recognised all of Hegelmaier's Australian species, and she described an additional new species (*C. capricorni* R.Mason). Treatments by Aston (1973), Orchard (1980) and Jeanes (1999) were all based on Mason's work, with no significant changes.

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The current treatment recognises eight species in Australia, four native and four introduced.

Materials and methods

This study is based on morphological examination of herbarium specimens, images of type specimens, and examination of live plants in habitat. Specimens have been examined from the following herbaria: AD, BRI, CANB, HO, MEL, NSW, PERTH, STU. Images of specimens from K have also been seen.

Taxonomy

Callitriche L., *Sp. Pl.* 969 (1753); *Gen. Pl.* ed. 5, 5 (1754). **Type:** *C. palustris* L.

Fragile-stemmed annual or perennial herbs, rooting at the nodes; either fully aquatic, amphibious, or prostrate and terrestrial on damp soil. Plants glabrous or with deciduous peltate scales on leaves and stems. Leaves simple, opposite, entire or nearly so, exstipulate, often dimorphic in aquatic and amphibious plants (narrower when submersed and broader distally, especially when floating or emersed). Petioles present, membranous, sometimes connate. Plants monoecious (usually) or dioecious (not in Australia). Inflorescence axillary, comprising 1 staminate

or 1 pistillate flower, or both together in the same leaf axil, sometimes subtended by a pair of minute, white, inflated bracts. Perianth absent. Staminate flower consisting of a single stamen; anthers 3– or 4–locular, not versatile; filament slender, usually lengthening before and after anthesis. Pistillate flower with 2 carpels; styles 2, terminal, slender, persistent or caducous; ovary superior, syncarpous; ovules 4 (1 per locule), pendulous, anatropous. Fruit somewhat flattened, splitting at maturity into 4 small, nutlike mericarps, these commonly winged along the margins, sometimes wingless, surface smooth or reticulate.

Key to native and naturalised (*) *Callitriche* taxa in Australia

1 Most or all leaves linear, more than 10 times longer than wide 2
Most or all leaves elliptic, spathulate, obovate or orbicular, 1–7 times longer than wide 4

2 Some fruits with pedicels 1–15 mm long; bracts absent . . . . . **5. *C. brutia** var. **brutia**
All fruits ± sessile (pedicels 0–0.5 mm long); bracts present 3

3 Fruit 0.9–1.2 mm broad, and length the same; fruit wing of constant width around mericarp; styles 0.8–1.6 mm long . . . . . **6. C. umbonata**
Fruit 0.7–0.8 mm broad, consistently longer than broad; fruits winged at distal end, but wing tapering to nothing at proximal end; styles 0.2–0.8 mm long . . . . . **7. *C. palustris** var. **palustris**

4 Fruits distinctly broader than long; plants terrestrial 5
Fruit length equal to width, or somewhat longer than wide; plants aquatic or semi-aquatic 8

5 Leaves rhomboidal to orbicular, often with a single tooth on one or both margins; wing of fruit very broad (25–35% of mericarp width) . . . . . **2. C. muelleri**
Leaves spathulate, obovate or elliptic, margins never toothed; wing of fruit 5–20% width of mericarp 6

6 Most fruits pedicellate, pedicels 0.5–4 mm long . . . . . **4. *C. deflexa**
All fruits ± sessile, pedicels 0–0.5 mm long 7

7 Fruits 1–1.2 mm broad; styles 0.8–1.6 mm long . . . . . **1. C. brachycarpa**
Fruits 0.65–0.8 mm broad; styles 0.1–0.3 mm long . . . . . **3. C. sonderi**

8 Fruits consistently longer than wide, width 0.7–0.8 mm; fruits winged at distal end, but wing tapering to nothing at proximal end . . . . . **7. *C. palustris** var. **palustris**
Fruit length virtually equal to width; fruits equally winged on all parts of mericarp, or wing almost lacking 9

9 Some fruits with pedicels 1–15 mm long; bracts absent; styles recurved . . . . . **5. *C. brutia** var. **brutia**
All fruits ± sessile (pedicels 0–0.5 mm long); bracts present; styles erect or spreading 10

10 Lower (submerged) leaves linear; fruits 0.9–1.2 mm long, brown . . . . . **6. C. umbonata**
All leaves spathulate to broadly-obovate; fruits 1.2–1.5 mm long, grey . . . **8. *C. stagnalis**

1. Callitriche brachycarpa Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 10: 115 (1869). **Type:** Victoria. tributary of the Plenty towards Mt Disappointment, 6 February 1853, *F.Mueller s.n.* (lecto: STU [here chosen]; isolecto: MEL 50296 & 50295).

***Illustration*:** Jeanes (1999: 461).

Terrestrial mat-forming forb. Leaves monomorphic, laminae broadly elliptic to broadly obovate, 2.1–4.1 × 1.4–2.5 mm, entire, apex obtuse; petiole 0.4–1.5 mm long, much shorter than lamina; peltate scales frequent. One staminate and one pistillate flower usually borne in the same leaf axil; bracts absent. Filaments 0.4–1.5 mm long; anthers 0.2–0.3 mm long, yellow. Styles 0.8–1.6 mm long, persistent, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.7–0.9 × 1–1.2 mm, not thickened or flared at base, dark brown, surface reticulate; wing absent to very narrow (<10% width of mericarp), evenly surrounding mericarp, cellular divisions not visible.

***Additional specimens examined*: Victoria**. Maits Rest Scenic Reserve, *c.* 6 miles [10km] W of Apollo Bay, Jan 1974, *Beauglehole ACB43987* (MEL); Wilsons Promontory N.P., Dec 1983, *Beauglehole ACB75955* (MEL); Apollo Bay, *s. dat., Mueller s.n.* (MEL). **Tasmania**. Hellyer Gorge, Hellyer River, *c.* 15 metres from east bank of river, Jan 1989, *Davies 1106* (CBG, MEL); 1.33 km north of The Shank, *Moscal 9787* (HO).

***Distribution and habitat*:** *C. brachycarpa* is endemic to Australia. In Victoria, it is known from the Otway Ranges and Wilson's Promontory (and the historical record from just north of Melbourne). It also occurs throughout western Tasmania at low altitudes (**Map 1A**). It grows on damp mud beside creeks and waterholes.

***Phenology*:** Flowers and fruits recorded from December to March.

***Typification*:** In his protologue for *C. brachycarpa*, Hegelmaier mentioned a specimen from Apollo Bay, sent to him by F. Mueller of Australia. The Apollo Bay specimen of *C. brachycarpa* at MEL is consistent with the protologue. However, the specimen at STU, labelled as *C. brachycarpa* and coming from Apollo Bay, does not match the details given in the protologue for *C. brachycarpa*. H. Schotsman determined the latter as *C. umbonata*, and I agree with that determination. Evidently Hegelmaier or a subsequent curator mixed up some of the material that was sent by Mueller. Because of the confusion with the Apollo Bay material, the other syntype at STU (Mt Disappointment) has been chosen as the lectotype.

***Notes*:** *C. brachycarpa* is readily distinguished by its terrestrial habit, short petioles, broader-than-long fruits and very long styles. It is apparently an uncommon species, and is recorded as Vulnerable in Victoria.

2. Callitriche muelleri Sond., *Linnaea* 28: 229 (1856). **Type:** Victoria. Latrobe River, April or May 1853, *F.Mueller s.n.* (lecto [here chosen]: MEL 2289178, ex herb. Sonder; isolecto: K 000348666, MEL 2289180 & 2289179A).

Callitriche macropteryx Hegelm., *Monogr. Callitriche* 59 (1864). **Type:** New South Wales. Hawkesbury River, 1802–1804, *F.Bauer s.n.* (syn: ?W; *n.v., fide* Mason (1959)).

***Illustrations*:** Jeanes (1999: 461); Aston (1973: 55).

Terrestrial mat-forming forb. Leaves monomorphic, laminae orbicular to rhomboidal, 1.4–2.9 × 1.4–3.3 mm, entire or with a tooth on one or both margins, apex obtuse; petiole 1.7–3.1 mm long, as long as or slightly shorter than lamina; peltate scales absent. One staminate and one pistillate flower usually borne in the same leaf axil, bracts absent. Filaments 0.1–0.2 mm long; anthers 0.1–0.15 mm long, yellow. Styles 0.1–0.2 mm long, persistent, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 1–1.3 × 1.2–1.4 mm, rarely thickened or flared at base, pale to dark brown, surface reticulate; wing very broad (25–35% width of mericarp), evenly surrounding mericarp or broader towards apex, cellular divisions often visible.

***Additional specimens examined*: Queensland.** Cook District: S.F.185 Danbulla, 1.7 km down Kauri Creek road, Jul 1994, *Forster PIF15606 et al.* (BRI, MEL). Leichhardt District: Mickey's Creek, Carnarvon Gorge, Mar 2001, *Fensham 4798* (BRI). Wide Bay District: Corella Creek, S.F. 700, N of Gympie, Oct 1993, *Bean 6705* (BRI). Moreton District: Brisbane

Forest Park, Enoggera Creek, Apr 1993, *Halford Q1674* (BRI); Kiamba *c.* 6 km W of Nambour, Jun 1990, *Sharpe 4950 & Bean* (BRI). **New South Wales.** Kioloa S.F., NE of Batemans Bay, Oct 1966, *Adams 1589* (CANB); near Brummies Lookout, SE of Tyalgum, Jan 1999, *Bean 14561* (BRI, MEL, NSW); base of Mt Killiekrankie, Oakes S.F., WSW of Bellingen, Jan 1999, *Bean 14596* (BRI); Couria Creek, Mt Dromedary, Jan 1970, *Burbidge 7817* (CANB); **Victoria.** Coranderrk Bushland Reserve, *c.* 4.5 km S of Healesville, Jan 1980, *Willis s.n.* (MEL); Lilly Pilly Gully, NE of Tidal River camp, Dec 1975, *Aston 1891* (CANB, MEL); Mallacoota Inlet N.P., Villarsia Creek, Dec 1969, *Beauglehole 32906* (MEL); Wallagaraugh River, *c.* 1 km downstream from Gipsy Point settlement, Oct 1991, *Walsh 3138* (MEL).

***Distribution and habitat*:** An indigenous species for Australia. *C. muelleri* is distributed more or less continuously in near-coastal areas from southern Queensland to western Victoria. Disjunct occurrences in Queensland include the Atherton Tableland and Carnarvon Gorge (**Map 1D**). It is also native in New Zealand, but strangely absent from Tasmania. It occurs on damp shady sites in rainforest or dense eucalypt forest.

***Phenology*:** Flowers and fruits throughout the year.

***Typification*:** There are Mueller specimens of *C. muelleri* labelled 'Latrobe River' at both MEL and K. The MEL sheet 2289178 is chosen as the lectotype, as it has the note "ex herbarium Sonder", and hence is the only sheet that was definitely seen by Sonder when drawing up his species description.

The type of *C. macropteryx* was not received on loan. However, its identity is clear. Hegelmaier soon reduced his *C. macropteryx* to synonymy with *C. muelleri* (Mason 1959), and so he clearly considered them conspecific. The large wing of the fruit, alluded to by the epithet *macropteryx*, is a diagnostic feature for *C. muelleri*.

***Notes*:** A very distinctive species because of its bright green, ± orbicular leaves and its broadly winged fruit.

3. Callitriche sonderi Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 9: 18 (1867). **Type:** Victoria. Station Peak [between Melbourne and Geelong], Australia Felix, *s. dat.*, *F.Mueller s.n.* (holo: STU; iso: MEL [2289177]).

Callitriche capricorni R.Mason, *Austral. J. Bot.* 7: 307 (1959), ***syn. nov.*** **Type:** Queensland. [Moreton District] Brisbane River, July 1874, *F.M.Bailey s.n.* (holo: BRI).

***Illustration*:** Jeanes (1999: 461)

Terrestrial mat-forming forb. Leaves monomorphic, laminae spathulate to narrowly-obovate, 1.4–3.7 × 0.4–2.1 mm, entire, apex obtuse; petiole 0.3–0.8 mm long, much shorter than lamina; peltate scales present. One staminate and one pistillate flower usually borne in the same leaf axil; bracts present, 0.2–0.4 mm long. Filaments 0.2–0.4 mm long; anthers 0.1–0.15 mm long, yellow. Styles 0.1–0.3 mm long, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.5–0.6 (–0.7) × 0.65–0.8 mm, sometimes thickened or flared at base, dark brown to black, surface reticulate; wing 5–10 (–20)% width of mericarp, evenly surrounding mericarp, cellular divisions not visible.

***Additional specimens examined*:** **South Australia**. River Murray, *c.* 1 km N of Murtho Park homestead, Sep 1979, *Barker 3978 & Barker* (AD, MEL); Cunnabuncha Waterhole on Strzelecki Creek, *c.* 15 km N of Merty Merty, Jul 1997, *Purdie 4484* (CANB). **Queensland.** Port Curtis District: margins of Lake Victoria, S of Dululu, Sep 1999, *Bean 15410* (BRI). Leichhardt District: Rolleston, backwash of the Comet River, Sep 1983, *Aston 2477* (AD, BRI, HO, MEL). Maranoa District: 5 km W of Mungallala, May 2002, *Bean 19022* (BRI). Warrego District: 56 km SSW of Eulo, 1973, *Pike s.n.* (BRI [AQ13188]). **New South Wales.** Montague Island, *c.* 9 km ESE of Narooma, Apr 1973, *Adams 3172* (CANB); Woomargama N.P., Spring Creek, *c.* 10.3 km S of Woomargama, Nov 2001, *Crawford 6819* (CANB); 'Bundycoola', Cobar, Aug 1974, *Cunningham 853* (NSW); 4km SE of 'Mt Mulyah' homestead, about 60 km NW of Louth, Sep 1978, *Moore 7921* (CANB). **Victoria.** Nip Nip, Hattah Lakes N.P., Sep 1969, *Anderson s.n.* (MEL); Hattah-Kulkyne N.P., Chalka Creek S of Lake Lockie, Oct 1982, *Cheal s.n.* (MEL); Tallangatta, May 1972, *Lumley 6* (MEL); Melton Reservoir, immediately on the N side of Ballarat railway line, May 2003, *Stajsic 3338 & Wlodarczyk* (MEL). **Tasmania**. Sea Elephant River, King Island, Jan 1979, *Morris 7950* (MEL).

***Distribution and habitat*:** *C. sonderi* is endemic to Australia. It is widespread in southern Queensland, much of New South Wales and Victoria, and in South Australia as far west as Coober Pedy. It is also known from King Island in Tasmania (**Map 1F**). It grows on damp soil adjacent to rivers, creeks and waterholes.

***Phenology*:** It flowers and fruits from April to October in the northern part of range, and throughout the year in the southern part of range.

***Typification*:** A single specimen of *C. sonderi* collected by Mueller exists at STU, and another is at MEL. Both are labelled 'Station Peak'. Hence, the STU specimen may be designated holotype.

***Note*:** It is not possible to maintain *C. capricorni* as a distinct taxon. Mason (1959) distinguished it from *C. sonderi* by the fruits. She said that *C. capricorni* has non-umbonate mericarps and a very wide commisural groove, and that *C. sonderi* has umbonate mericarps and a narrow commisural groove. However, a wide range of variation occurs in the fruits of *C. sonderi,* and the capricorni-type fruit is merely one form of that variation. Fruit morphology does not appear to be correlated to other characters or to geography.

4. *Callitriche deflexa A.Braun ex Hegelm., *Monogr. Callitriche* 58, t. 3 (1864). **Type:** Brazil. Rio de Janeiro, 1859–60, *F.Rudio,* ex herb. A. Braun (syn: CM, GH, MO; *fide* Lansdown (2006a: 115)).

[*C. marginata* in J.H. Ross & N.G.Walsh, *A Census of the Vascular Plants of Victoria*, Seventh Edition (2003).]

Terrestrial mat-forming forb. Leaves monomorphic, laminae spathulate to elliptic, 1.3–3 mm × 0.5–1.6 mm, entire, apex obtuse; petiole 0.5–2 mm long, shorter than lamina; peltate scales present. One staminate and one pistillate flower usually borne in the same leaf axil, bracts absent. Filaments 0.3–0.5 mm long; anthers 0.1–0.15 mm long, yellow. Styles 0.2–0.8 mm long, recurved. Fruiting pedicels 0.5–3 mm long. Mature fruits (including wing) 0.5–0.7 × 0.7–0.9 mm, not thickened or flared at base, dark brown to black, surface reticulate; wing very narrow (<10% width of mericarp), evenly surrounding mericarp, cellular divisions not visible.

***Specimens examined*: Victoria.** Nursery/glasshouse site, Royal Botanic Gardens, Melbourne, Jul 2000, *Stajsic 2963* (MEL); NW end of the Ornamental Lake, Royal Botanic Gardens, Melbourne, Nov 2002, *Stajsic 3319* (MEL); western bank of Long Island, Royal Botanic Gardens, Melbourne, Sep 2001, *Walsh 5392* (CANB, MEL).

***Distribution and habitat*:** *C. deflexa* is currently known only from the Melbourne Botanic Gardens at South Yarra (**Map. 1C**), where it grows on mud beside lakes, and along shaded paths, in cracks between paving bricks. Naturalised occurrences are also known from Portugal, Morocco, Tanzania and South Africa (R. Lansdown pers. comm.). It is native to the east coast of South America, and a few places in central America.

***Phenology*:** This species appears to flower and fruit throughout the year.

***Notes*:** *C. deflexa* closely resembles *C. sonderi*, but differs from it by the absence of bracts, the distinctly pedicellate fruits and the longer styles.

5. *Callitriche brutia Petagna, *Inst. Bot.* 2: 10 (1787). **Type:** Italy. Calabria. ex herb. Petagna (lecto: FI; *n.v., fide* Schotsman (1967: 85)).

[*C. hamulata auct. non* Kütz. in W.D.J.Koch: Mason (1959: 323); Aston (1973: 53).]

***Illustrations*:** Jeanes (1999: 461); Aston (1973: 55), both as *C. hamulata.*

Aquatic forb. Leaves dimorphic, lower leaves evenly spaced, linear, 7–23 mm × 0.4–0.8 mm, entire, apex deeply notched, petiole absent; upper leaves clustered, spathulate to obovate, 4–7 × 0.6–3.4 mm, apex obtuse or emarginate, petioles present, intermediate leaf forms common; peltate scales present. Staminate and pistillate flowers borne in different leaf axils, bracts absent. Filaments 0.2–1 mm long; anthers *c.* 0.1 mm long, translucent or white. Styles 0.3–0.9 mm long, recurved. Fruiting pedicels 0.5–15 mm long. Mature fruits (including wing) 0.9–1.2 × 0.8–1.2 mm, not thickened or flared at base, pale to dark brown, surface smooth or reticulate; wing absent or very narrow (<10% width of mericarp), evenly surrounding mericarp, cellular divisions not visible.

***Additional specimens examined*: Western Australia.** Benger, 90 miles [145 km] S of Perth, Oct 1963, *Hitchcock s.n.* (CANB); Tuart forest, SW of Ludlow, Sep 1994, *Keighery 13373* (PERTH); 1 km south-west of Capel, Sep 1988, *Keighery 10470* (PERTH). **South Australia.** Comaum, *Alcock 5* (AD). **New South Wales.** western Wanganella Swamps, in travelling stock reserve, Sep 1990, *Roberts 671* (CANB). **Victoria.** *c.* 15 miles [24 km] WNW of Ararat, 3 miles [5km] SE of Pomonal,

Nov 1965, *Aston 1408* (MEL); Winton Swamp, 9 miles [14 km] ENE of Benalla, Sep 1960, *Aston 621* (MEL); Gunbower Forest, north of the Koondrook Track, Oct 1981, *Scarlett 18-140* (MEL); Baddaginnie district, Aug 1988, *Strudwick JES0012* (MEL); Linton, 1912, *Williamson 1499* (MEL). Tasmania. Houfes nad, King Island, Oct 1998, *Woolley & Askey-Doran s.n.* (HO).

***Distribution and habitat*:** *C. brutia* var. *brutia* is naturalised in Australia, especially in Victoria, but also in adjacent parts of New South Wales and South Australia, and in the south-west of Western Australia (**Map 1B**). It grows in shallow water, in drains, creeks and dams. It is also naturalised in New Zealand. It has a wide native distribution, including Europe, Greenland, Morocco, Iran and the Caucasus.

***Phenology*:** Flowers and fruits throughout the year.

***Notes*:** This taxon has been called *C. hamulata* in Australia since the revision of Mason (1959). Lansdown (2006a) recently reduced *C. hamulata* to a variety of *C. brutia*. However, it is the typical variety that is found in Australia. The first specimen record for Australia was that collected in 1912 from Linton, Victoria.

6. Callitriche umbonata Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 9: 19 (1867). **Type:** Tasmania. South Esk, 1848–1857, *C.Stuart s.n.* (lecto: STU [here chosen]; isolecto MEL 2289182B & 2289185).

Callitriche cyclocarpa Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 10: 116 (1869), ***syn. nov.*** **Type:** Victoria. Yarra Yarra, *s. dat., F.Mueller s.n.* (holo: STU; iso: MEL 224504).

***Illustration*:** Jeanes (1999: 461)

Aquatic or amphibious forb. Leaves dimorphic, lower leaves evenly spaced, linear, 3.5–6 × 0.2–0.6 mm, apex obtuse or emarginate, petiole absent; upper leaves clustered or evenly spaced, spathulate to elliptical, 2.5–6 × 1.8–3 mm, apex obtuse, petioles present, shorter or longer than lamina, intermediate leaf forms occurring; peltate scales present. Staminate and pistillate flowers usually borne in same leaf axils; bracts present, 0.6–1 mm long. Filaments 0.2–1.6 mm long; anthers 0.1 mm long, white. Styles 0.8–1.9 mm long, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.9–1.2 × 0.9–1.2 mm, slightly thickened at base and sometimes umbonate, pale to dark brown, surface reticulate; wing 10–20% width of mericarp, evenly surrounding mericarp, cellular divisions sometimes visible.

***Additional specimens examined*: South Australia.** Mt Monster Conservation Park, *Murfet 2060 & Taplin* (AD). **New South Wales.** Macquarie Marshes 20 km NW of 'Sandy Camp', Aug 1979, *Paijmans 3175* (CANB); Western Wanganella Swamps, Sep 1990, *Roberts 671* (CANB); Cooleman Plain, just below Cooleman Range, 17 miles [28.3 km] NNE of Kiandra, Dec 1969, *Rodd & Coveny 2682* (NSW). **Victoria.** Hawkesdale, Nov 1903, *Williamson s.n.* (MEL); Glenorchy, 12 miles [20 km] NW of Stawell, Sep 1960, *Beauglehole ACB6772* (MEL); Mitre Rock, N of Mt Arapiles, Nov 1968, *Beauglehole ACB29880* (MEL). **Tasmania.** Jericho, Midlands Highway, Oct 1970, *Morris s.n.* (HO).

***Distribution and habitat*:** *C. umbonata* is endemic to Australia. It is of scattered occurrence in New South Wales, Victoria, the south-east of South Australia, and Tasmania (**Map 1H**), in rock pools, shallow streams or billabongs.

***Phenology*:** Flowers and fruits are borne from August to December.

***Typification*:** In the protologue for *C. umbonata*, Hegelmaier cited three specimens/locations – "Tasmania, Stuart; in stagnant pools near Melbourne, Nov 1852, Mueller; Darebin Creek, Mueller". Mason (1959) referred to the presence of a 'Darebin Creek' syntype at STU, but specimens loaned from STU included no such specimen. Two *C. umbonata* specimens were received from STU. One is labelled "in stagnant pools near Melbourne", but the specimen is tiny and is obviously just a small fragment of the original material that Mueller would have sent. The second specimen is of good size and matches the protologue well. It is labelled "South Esk, Tasmania", and was undoubtedly collected by Charles Stuart, as determined by Mason (1959). This latter specimen is chosen as the lectotype.

***Notes*:** The fruits on the type specimen of *C. cyclocarpa* are smaller and with a narrower wing than those commonly attributed to *C. umbonata*. However, a small proportion of the fruits on the *C. umbonata* type material are a very good match for those on the *C. cyclocarpa* type. I contend that the

fruits of the *C. cyclocarpa* type specimen are merely immature, and that the specimen represents *C. umbonata*. No other character separates *C. cyclocarpa* from *C. umbonata*. Significantly, when Hegelmaier described *C. cyclocarpa*, he compared it with *C. verna*, *C. muelleri*, *C. stagnalis* and *C. hamulata*, but not with *C. umbonata*.

C. umbonata is a poorly collected species, and may be easily confused with *C. brutia* var. *brutia*.

7. *Callitriche palustris L., *Sp. Pl.* 2: 969 (1753). **Type:** the three lower specimens, Herb. Linn. No. 13.1 (lecto: LINN; *fide* Lansdown & Jarvis (2004: 169)).

Callitriche verna L., *Fl. Suec.*, ed. 2: 2 (1755). **Type:** Herb. Linn. No. 13.2 (lecto: LINN; *fide* Lansdown & Jarvis (2004: 171)).

***Illustration*:** Jeanes (1999: 461)

Aquatic or amphibious forb. Leaves dimorphic; lower leaves evenly spaced, narrowly-elliptic to linear, 3–4.5 × 0.3–0.7 mm, entire, apex obtuse or emarginate, petiole absent; upper leaves clustered or evenly spaced, spathulate to broadly-elliptic, 2.2–5 × 0.9–2 mm, apex obtuse, petioles present, shorter or longer than lamina, intermediate leaf forms occurring; peltate scales present. Staminate and pistillate flowers usually borne in same leaf axils; bracts present, 0.4–0.6 mm long. Filaments 0.2–0.4 mm long; anthers *c.* 0.2 mm long, white. Styles 0.2–0.8 mm long, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 0.8–1 × 0.7–0.8 mm, not thickened or flared at base, brown, surface reticulate; wing 10–20% width of mericarp, present only along distal half, cellular divisions sometimes visible.

***Additional specimens examined*: Victoria.** Mt Pinnibar Hut area, 6.5 miles [10.8 km] direct north of Mt Gibbs, Feb 1973, *Beauglehole ACB41596 & Rogers* (MEL); Biggara, Nov 1928, *Williamson s.n.* (MEL); South Bryce Plain, Snowy Range, Nov 1980, *Walsh 971* (MEL); Cobbaras Mts, playground under S side of Cobbaras, Feb 1974, *Willis s.n.* (MEL).

***Distribution and habitat*:** *C. palustris* is naturalised in Australia, and confined to eastern Victoria (and probably adjacent New South Wales), often at altitudes exceeding 1000 metres (**Map 1E**). This very widespread taxon is native in Europe, temperate Asia, and much of North America. It grows in shallow water e.g. drains, ponds, dams.

***Phenology*:** Flowers and fruits recorded from November to February.

***Notes*:** According to the key provided in Lansdown (2006b), the taxon occurring in Australia is *C. palustris* var. *palustris*.

Specimen citations by Mason (1959) suggest that the first Australian record was in 1874 from "lower Hume's [=Murray] River", on the Victoria-New South Wales border. I have not seen that specimen.

Specimens lacking mature fruits may be difficult to distinguish from *C. umbonata*.

8. *Callitriche stagnalis Scop., *Fl. Carniol.* ed. 2, 2: 251 (1772). **Type:** United Kingdom (Wales). Aberleri Fields, Borth, 20 July 1998, *A.O.Chater s.n.* (neo: NMW; *fide* Lansdown (2006a: 108)).

***Illustrations*:** Jeanes (1999: 461); Aston (1973: 58).

Aquatic or amphibious forb. Leaves monomorphic, sometimes clustered near apex; laminae spathulate to broadly-obovate, 2.6–7 × 1.5–5.1 mm, entire, apex obtuse; petiole 1.2–4.2 mm long, usually shorter than lamina; peltate scales present. Staminate and pistillate flowers borne in the same or separate leaf axils; bracts present, 0.3–0.9 mm long. Filaments 0.7–2.5 mm long; anthers 0.15–0.3 mm long, yellow. Styles 0.5–2.3 mm long, persistent, not recurved. Fruiting pedicels absent. Mature fruits (including wing) 1.2–1.5 × 1.2–1.5 mm, occasionally rarely flared at base, grey, surface smooth; wing moderate (10–20% width of mericarp), evenly surrounding mericarp, cellular divisions not visible. *Common water-starwort*.

Additional specimens examined: **Western Australia.** Kenwick, south of Perth, Nov 1993, *Jacobs 6949* (MEL); 1.8 km S of Willyung–Parkerbrook Road, on Rocky Crossing Road, *c.* 7.5 km NW of Albany, Nov 1995, *Lepschi & Lally 2367* (CANB, MEL, PERTH). **South Australia.** Brockhoffs, Nov 1991, *Bates 26233* (AD, MEL); Mount Lofty Ranges, Stirling West, near Mount Lofty, Jan 1957, *Ising s.n.* (MEL); 3 km north of Yundi, 55 km S of Adelaide, Sep 1957, *Schodde 498* (CANB). **Queensland.** Leichhardt District: Crystalbrook, NW of Injune, Oct 1999, *Fensham 3854*

(BRI). WIDE BAY DISTRICT: adjacent to Witta cemetery, N of Maleny, Oct 2000, *Bean 16914* (BRI). **New South Wales.** 3.4 km along Majors Point road, NE of Ebor, Feb 2001, *Bean 17350* (BRI, NSW); Rocky River, 35 km NE of Glen Innes via Gwydir Highway, Aug 1987, *Hind 5254 & D'Aubert* (MEL, NSW); banks of Namoi River, Warrabah N.P., Sep 1994, *Hosking 994* (CANB); Wingecarribee Swamp, *c.* 2.5 km NE of Burrawang, *c.* 4.5 km due WNW of Robertson, Sep 1992, *Kodela 188* (CANB); Bondo S.F., Dubbo Creek *c.* 7 km S along Broken Cart Fire Trail, Feb 1999, *Taws 925* (CANB). **Australian Capital Territory.** Black Mountain slopes, Australian National Botanic Gardens, Oct 1985, *Ward 157* (CBG). **Victoria.** *c.* 4 miles [6 km] WSW of Stawell, on road to Halls Gap, Nov 1965, *Aston 1411* (MEL); Orbost Rifle Range area, Orbost, Nov 1970, *Beauglehole ACB34514* (MEL); Splitters Range Forest Block, 6 km SSW of Mount Tambo, Dec 1984, *Carr 10189* (MEL); Boundary Creek, Wulgulmerang, Nov 1962, *Willis s.n.* (MEL). **Tasmania.** drainage ditch, corner Montagu Road and Bolduans Road, Nov 2004, *Duretto 1811* (CANB); Melaleuca, Apr 1992, *Jacobs 6465* (HO, MEL, NSW); Henty Bridge on Strahan – Zeehan road, Dec 1981, *Orchard 5744* (CANB).

***Distribution and habitat*:** *C. stagnalis* is widely naturalised in Australia, occurring in south-east Queensland, eastern New South Wales, much of Victoria and Tasmania, south-eastern South Australia and south-western Western Australia (**Map 1G**). It is also naturalised in New Zealand and North America. It has a broad native distribution in Europe and western Asia. It grows in the shallow water of drains, pools and creeks, and sometimes in mud where water has receded.

***Phenology*:** Flowers and fruits throughout the year.

***Note*:** The first Australian specimen records were in 1881 (Sydney area) and 1882 (near Adelaide). It is now the most widespread and abundant alien *Callitriche* species in Australia.

Excluded Names

Callitriche antarctica Hegelm., *Verh. Bot. Vereins Prov. Brandenburg* 10: 115 (1869). **Type:** Antarctic Archipelago, *J.D.Hooker s.n.* (syn: *n.v.*); Kerguelen Island, May–July 1840, *J.D.Hooker* (syn: *n.v.*); Campbell Island, Dec. 1840, *J.D.Hooker* (syn: NSW).

Mason (1959) reported a specimen citation by Fassett in 'Callitriche of the New World' (1951), recording *C. antarctica* for Tasmania, supposedly collected by Gunn. No further records have been forthcoming and it seems highly likely that this citation is erroneous, and that the species is absent from Australia, excluding island territories, already documented by Orchard (1993).

Callitriche platycarpa Kütz. in Reichenb., *Ic. Plant. Crit.* cent. ix: 38 (1831). **Type:** Magdeburg, Germany, received 1865, *W.F.R.Suringar* (lecto: L; *fide* Lansdown (2006a: 109)).

Hooker (1859) referred to this species occurring on the Antarctic Islands. However, the only species known from these islands is *C. antarctica.*

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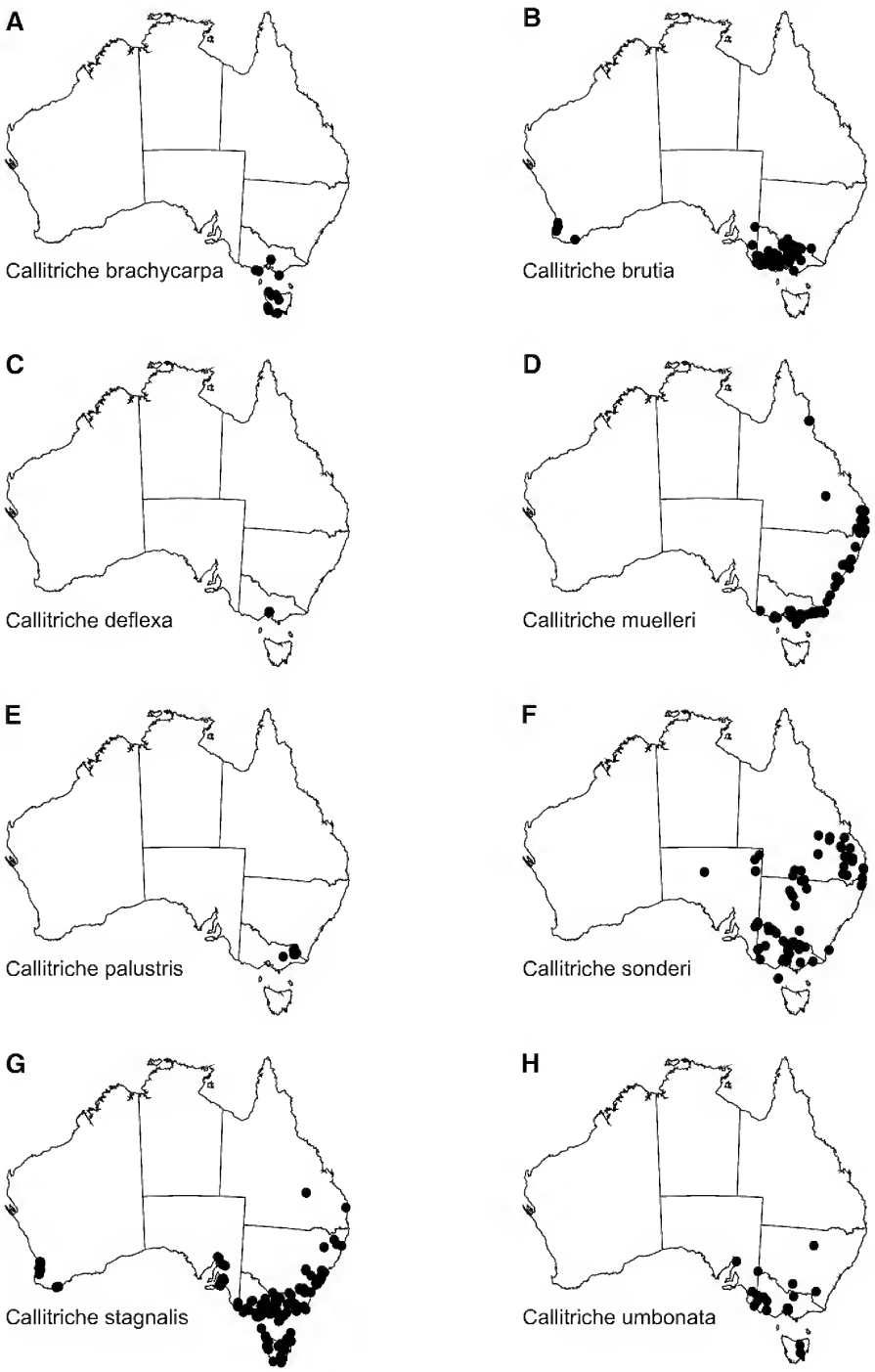

Map 1. Distribution of *Callitriche* spp. in Australia

F.M.Bailey's ascent of Mt Bellenden-Ker in 1889, and notes on the publication priority of new vascular plant species from the Expedition

John Leslie Dowe & Alan D. Broughton

Summary

Dowe, J.L. & Broughton, A.D. (2007). F.M.Bailey's ascent of Mt Bellenden-Ker in 1889, and notes on the publication priority of new vascular plant species from the Expedition. *Austrobaileya* 7(3): 555–566. The route of A.Meston's Bellenden-Ker Range Expedition of 1889 and F.M.Bailey's itinerary were determined from Meston's narrative of the Expedition. Many of the species that Bailey described from the Expedition were published as new species in as many as four publications. The chronology of the four publications has been established thus providing a priority of publication for the names involved.

Key Words: F.M.Bailey, A.Meston, Bellenden-Ker botany, publication priority, Queensland flora

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Introduction

One of F.M.Bailey's most productive collecting and taxonomic periods resulted from his participation in Archibald Meston's Government Scientific Expedition in 1889 to the Bellenden-Ker Range in north-east Queensland (White 1950; Hall 1978; Sanderson 2007), with almost 100 new taxa being described, mostly by Bailey himself. Bailey was one of two scientists on the Expedition, the other being zoologist Kendall Broadbent, a collector for the Queensland Museum. The Expedition departed Cairns on June 14, 1889, and during the ensuing 67 days, ascended Mt Bellenden-Ker [with a brief climb by Meston to the summit of Mt Bartle Frere (20–23 July)], as well as exploring the Mulgrave River, Harvey Creek, and Russell River areas. The Expedition returned to Cairns on August 19, 1889.

As an introduction to the taxonomic assessment, and to place in context the collection localities, this paper examined Meston's accounts and provides the most likely route that was taken by Bailey in his ascent and descent of Mt Bellenden-Ker. Some comments on the vegetation, as described by Meston, are also provided. In addition to the higher plants and ferns which are discussed here, Bailey (1890b, 1891) prepared lists of the fungi, mosses, liverworts and lichens collected during the Bellenden-Ker Expedition, but aspects regarding the publication priority of these taxa are beyond the scope of this paper.

With regard to the route and itinerary, only the ascent and descent of Mt Bellenden-Ker, which occupied the period 15 June to 17 July, is examined here in detail. However, the assessment of Bailey's taxonomic accounts deals with the entire Expedition.

The Bellenden-Ker Range Expedition

Meston (1889a–j) provided a detailed, though somewhat romanticized, account of the Bellenden-Ker Range Expedition, and with specific focus on the actual ascent and subsequent descent in the company of F.M.Bailey. However, Meston provided only a meagre description of other localities visited during the Expedition, such as Mulgrave River, Harvey Creek and Russell River, and consequently the route to these areas was not able to be determined with acceptable accuracy.

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Despite Mt Bellenden-Ker having apparently been ascended at least twice before by European explorers (Johnstone 1874; Sayer 1888), Meston was subsequently adamant that none of the previous attempts indeed reached the summit, and that he was the first non-indigenous person to do so. Meston's narrative is generally correct in geographical content. However, it is in some instances obscure with regard to location details as many of the topographical features of Mt Bellenden-Ker were not well defined at the time. The names of some of the peaks on the Bellenden-Ker Range described by Meston do not agree with the names on current topographical maps and this had led to some difficulties initially in interpreting the route taken by the Expedition. Some of the names used by Meston in 1889 that now refer to different peaks are: Mt Toressa for Mt Sophia, Mt Sophia for the northern-most high peak of the Bellenden-Ker Range (1280 m), South Peak for a small peak (1550 m) to the west-southwest of Centre Peak and Mt Harold for Mt Massey. Early names for some streams were also used by the Expedition, for example present-day Behana Creek was referred to as Tringilburra Creek. Understanding the different names was critical in determining the route of the ascent.

Of the altitude readings taken by Meston, only those recorded during the first week can be considered of sufficient accuracy to be used to locate the Expedition's position on a modern contour map. After that time, without frequent recalibration of the barometer, the altitude readings become less accurate and more problematic. Meston placed the Expedition's highest camp on his 'south peak' at a height of 5000 ft (1524 m). The true South Peak, as indicated on modern maps, is about 4.5 km (2.8 miles) away to the SSE at a height of about 1211 m (4000 ft). Meston appears to be describing a part of a plateau region about 1540 m (5050 ft) in height to the west and about 1 km from the Centre Peak, the highest point on the Bellenden-Ker Range at 1582 m (5189 ft). During the Expedition's stay at Meston's 'south peak', Meston ascended the highest point and a smaller peak about 400 m to the north at a height of 1555m (5100 ft).

Determining the route

Meston's reports (Meston1889a–j) contain much valuable information made from his observations and measurements during the ascent of Mt Bellenden-Ker. He described the mountain and creek systems in detail, the types of vegetation encountered, locations of campsites, local geology and activities carried out by members of the Expedition. He also recorded barometric heights, temperatures, distances travelled and directions taken.

Meston used a compensated aneroid barometer to measure heights (Meston 1889a). Measurement of altitude depends on the difference in air pressure between two points in a vertical column of air. Within this column, pressure variations are also caused by (1) changing temperature of the air column, (2) diurnal variations, and (3) movements of pressure systems. Where the pressure variations due to (1) and (2) support each other, errors up to 3–4% in the recorded altitude could occur (BoM 1966; SRBV 1997). Allowing for possible errors as outlined above, Meston's initial barometric heights can still be used with some confidence to support or substantiate his position already determined from his descriptions and distances travelled. The location of the highest camp, South Peak Camp was determined by Meston's description of the whole south end of Bellenden-Ker from the Centre Peak broadening out to be about 1 km in width. His barometer gave a height of 5000 feet (1525 m) (Meston 1889a). The Bartle Frere map shows in this area a relatively flat triangular region of height 1520 m dominated by three small high points each of height of about 1540 m but less than 1560 m and all about 300 m apart. The high point nearest to the ridge climbed and west-southwest of the Centre Peak is the most likely site for this camp at 1550m.

All this information was evaluated and assessed and apart from some discrepancies discovered during this process relating to Meston's use of mountain names (mentioned above), the detail was sufficient to allow described features to be readily identified on the Bartle Frere 1:100,000 Topographical Survey map, Series R631, Sheet 8063, Edition 2-AAS. The estimated route of Bailey's sector of the Expedition is provided in **Fig. 1**.

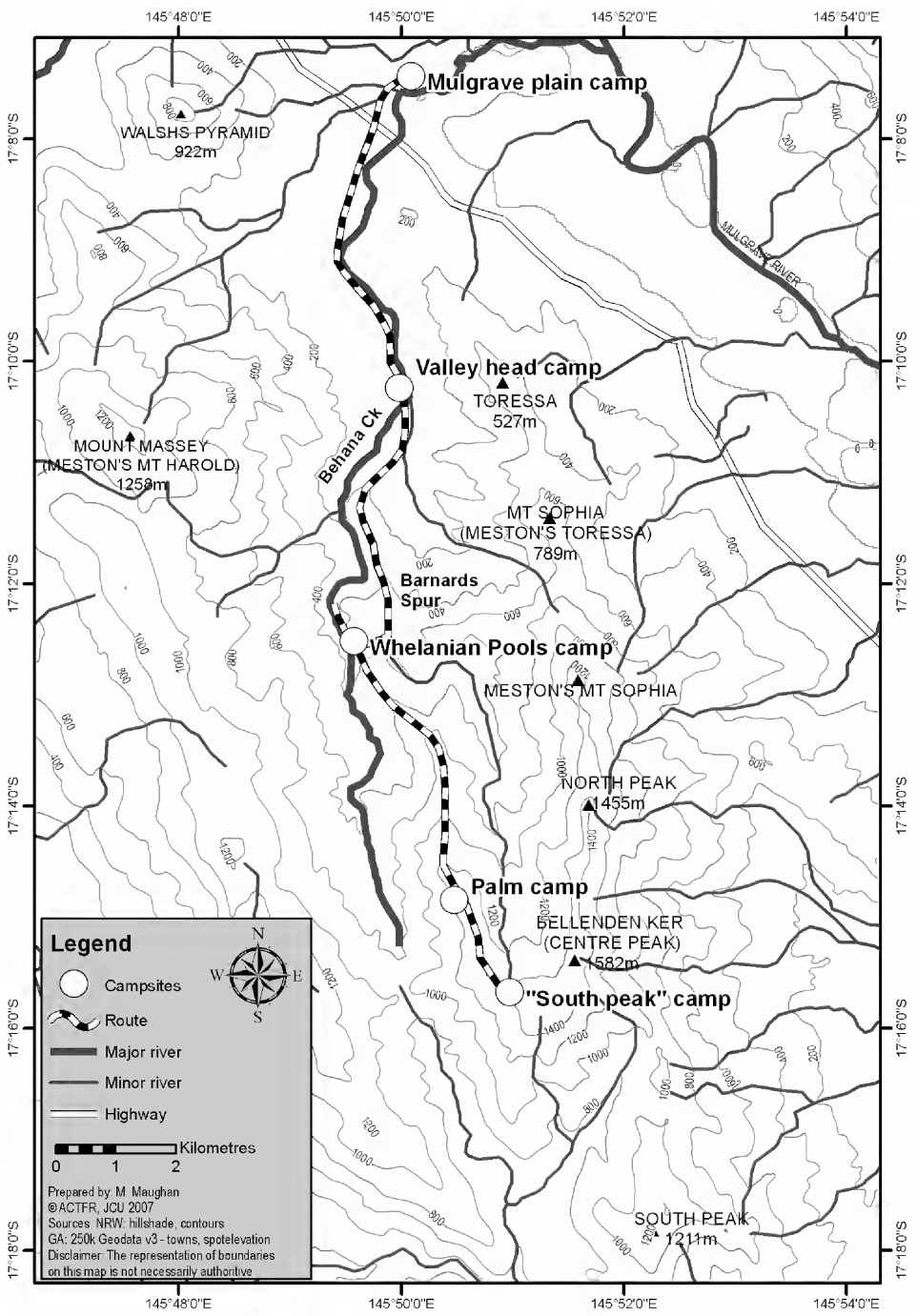

Fig. 1. Estimated route taken by F.M.Bailey during the Bellenden-Ker Expedition, 1889, based on data in Meston (1889 a–j). Map prepared by Jonah Sullivan and Mirjam Maughan, ACTFR, Townsville.

Description of the route

The Expedition left the 'Mulgrave Plain Camp' (about 4 km east of Walsh's Pyramid) on Behana Creek (named as Tringilburra Creek) on 16 June 1889 and travelled 7 km up Behana Creek on horseback over level open-forested country to the junction of a creek draining the western slopes of Mt Sophia (current name) and Behana Creek. 'Valley Head Camp' was made at this junction, which was also at the foot of Barnard's Spur, so named by Meston in February 1889 while on a previous expedition (Meston 1889k; Barnard 1962). The next day, the Expedition now on foot, ascended the spur, the crest of it being open forest and rising 500 m in 5 km in a southerly direction before descending steeply 200 m into the Behana Creek gorge. At this point the two main tributaries of Behana Creek join. The 'Whelanian Pools Camp' was made on large slabs of granite by the creeks. The next two days were used to collect specimens along the steep and rocky creek gorges.

On 20 June the party began the long climb to the top of Mt Bellenden-Ker. The ridge selected by Meston during the February 1889 Expedition ran slightly east of south from the junction of the two creeks at the 'Whelanian Pools Camp' to just west of the summit of Mt Bellenden-Ker, a distance of about 7 km and rising from 300 m to about 1500 m. This section of the climb was in dense rainforest along a narrow ridge not more than 6 m wide in places, with steep slopes on both sides. Progress was slow as the track had to be cleared of lawyer vine, stinging trees and thick vegetation so that the Aboriginal carriers following were not obstructed. 'Palm Camp' was set up at about 1200 m on 20 June, and 'South Peak Camp' at 1550m three days later, about 1 km west-southwest of Mt Bellenden-Ker Centre Peak. Collections were made at 'Palm Camp' on 20–21 June and at 'South Peak Camp' from 23-26 June, before the Expedition returned to lower altitudes. Only Meston, his son and Broadbent and an Aborigine, Multarri, climbed to the summit of Mt Bellenden-Ker at a height of 1582 m. The climb was made in mid-winter. At the 'South Peak Camp', Meston recorded midday temperatures ranging from 13°C to 18°C and night temperatures ranging from – 1°C to 9°C. Most of the collecting at the high elevation camps was done in rain or cloud.

Collections and vegetation

Bailey collected mostly near the camps, as well as along the routes between camps, and did not venture too far away from these areas.In contrast, Meston and others, not only collected near the camps, but ranged further afield during the expedition (Meston 1889b). Meston (1889e) also collected plant specimens on Bailey's behalf during the Expedition. In his reports, Bailey listed collection localities such as Mt Bartle Frere, Mt Massey (Meston's Mt Harold) and Walshs Pyramid, places that Bailey did not visit during the Expedition. In some instances, specimens have been cited with Meston as a co-collector (see Chew (1972), for type collection of *Piper mestonii* F.M.Bailey and Chew (1989), for type collection of *Ficus crassipes* F.M.Bailey), while many have been cited merely as 'Bellenden-Ker Expedition' without reference to actual collector. Bailey's Bellenden-Ker Expedition itinerary is presented in **Table 1**.

Overall, little can be gleaned from Bailey's accounts with regard to the vegetation types through which they traveled and made collections. In his reports, his references to vegetation were limited to descriptors such as 'scrubs', 'tropical scrubs' and 'rich scrubs', which appear to be synonymous with closed forest and/or rainforest; 'scrub borders' which may distinguish some ecotones; and 'scrubs bordering rivers' which refer to riparian vegetation. On the contrary, Meston's reports were descriptive of the vegetation, and he provided, sometimes with acknowledged assistance from Bailey, details of species composition and distribution, as part of his accounts of the daily routine of the Expedition. In his '*The Flora of Wooroonooran*', Meston (1889j) provided a summarised account of the vegetation experienced during the Expedition, albeit "*...a very brief description of the specially interesting section of the Bellenden-Ker flora, and intended for the ordinary reader who either dreads or has no desire for a personal orthographical struggle with Mr. Bailey's official report*". In a general

Table 1. F.M.Bailey's itinerary during the Bellenden-Ker Expedition, 1889.

Date	Movements and collecting locations
4 June	depart Brisbane
9 June	arrive Cairns
14 June	depart Cairns for Bellenden-Ker Range
15 June	arrive Tringilburra (Behana) Creek, edge of Mulgrave Plain
16 June	arrrive head of Behana Creek valley
17 June	ascend Barnards Spur, camp at Whelanian Pools
18–19 June	collect around Whelanian Pools
20–21 June	ascend to Palm Camp, collect locally
22 June	ascend to 'south peak' [west-southwest of Centre Peak on modern maps]
23–26 June	collect around 'south peak' [west-southwest of Centre Peak on modern maps]
27 June	descend to Palm Camp
28 June–1 July	collect around Palm Camp
2 July	descend to Barnards Spur, camp overnight
3 July	descend to head of Behana Ck valley
4–10 July	collect in Behana Creek valley area
11 July	move to Behana Creek camp, edge of Mulgrave Plain
12–17 July	collect in Behana Creek camp area
18–25 July	travel to Russell River and Harvey Creek, collect locally
26 July	travel to Mulgrave River
27 July–18 August	collect along Mulgrave River
19 August	return to Cairns
20 August	Cairns
21–26 August	visit Freshwater Valley
27 August	depart Cairns
2 September	arrive Brisbane

context, Meston described the whole range as being "*clothed in dense tropical jungle from base to summit, there not being a single open space 50 ft. square, except a patch of ferns on the south spur at 2700 ft., and a few hundred yards of forest on the west spurs of mounts Sophia and Toressa*".

In the lower portion of the ascent, Meston (1889a) described the vegetation of Barnard's Spur as "*chiefly bloodwood, Moreton Bay ash and the Casuarina*". He used the term 'forest' for this moist sclerophyll vegetation, as opposed to 'scrubs', 'thick scrub' or 'dense tropical scrubs' for complex closed forest or rainforest. As Meston began his ascent into the higher elevations he noted, at about 1200 m, "*many tall trees... especially Kauri pines, which attain gigantic dimensions. The lawyer vine and stinging tree are left behind at about 2000ft, but all the way up it is a thick wiry undergrowth*". At Meston's 'south peak', at about 1550 m, "*the vegetation here is one tangled solid mass, impenetrable without the cane-knife*". To reach the Centre Peak, Meston had to cut "*through indescribable vegetation, the worst of which is a dracophyllum tree... tough, gnarled, wiry branches all tangled together*". Upon reaching the summit, the "*trees are nearly all short and gnarled, and all, without exception, hard as bone*" and "*conspicuous among the vegetation is a dome-topped tree with foliage so thick that not a ray of sunshine penetrates*". The latter refer to *Dracophyllum sayeri* F.Muell. and *Leptospermum wooroonooran* F.M.Bailey, respectively.

The potential of many species as useful fruits was optimistically expounded by Meston, such as *Acronychia acidula* F.Muell., *Antidesma bunius* (L.) Spreng., *Citrus inodora* F.M.Bailey, *Davidsonia pruriens* F.Muell., *Garcinia mestonii* F.M.Bailey, *Macadamia whelanii* (F.M.Bailey) F.M.Bailey, *Myristica insipida* R.Br., *Piper mestonii* F.M.Bailey and *Rhodomyrtus macrocarpa* Benth., as well as various native grapes, the Burdekin Plum, beans, nuts, cherries, berries and figs. Among perfume-bearing plants, Meston included *Dracophyllum sayeri*, an unnamed '*Hollandaea* sp.', *Orites fragrans* F.M.Bailey and orchids. As for potential garden ornamentals, Meston noted *Helicia nortoniana* (F.M.Bailey) F.M.Bailey, *Mullerochloa moreheadiana* (F.M.Bailey) K.M.Wong and *Schefflera actinophylla* (Endl.) Harms. He noted the restricted distribution of *Acronychia chooreechillum* (F.M.Bailey) C.T.White, *Crepidomanes pallidum* (Blume) K.Iwats. and *Leptospermum wooroonooran* to the summits of peaks. The achievements of the Expedition were remarkable considering the impenetrability of the vegetation, the steepness of the topography, the almost constant rain and the very low temperatures in the higher elevations.

New taxa described from the Bellenden-Ker Range Expedition

A perusal of taxonomic citations in Chapman (1991), APNI (2005) and numerous other publications, of the taxa that were described from the Bellenden-Ker Expedition (Bailey 1889a–c, 1890a–b, 1891), revealed that the publication citation data for them were overall inconsistent and contradictory. In effect, new taxa were nominally published as '*n. sp.*', up to four times in separate publications, and priority had not been fully resolved for many of them. This paper aims to compare the publications in which the new taxa were 'published', and resolve the publication priority issue.

The four publications in which taxa were described as '*n. sp.*' are:

1. '*Report on New Plants, Preliminary to General Report on Botanical Results on Meston's Expedition to the Bellenden-Ker Range, by F.M. Bailey, F.L.S., Colonial Botanist*'. This report is dated 1 October 1889 by what appears to be Bailey's hand.

In this publication, 17 new taxa (one genus and 16 spp.) are listed alphabetically by genus, designated as '*n. sp.*' and with a detailed description and distribution details. The publication appears to have been type-set, and consists of three pages. It is not known how many copies were produced or to whom they were distributed, and the document is exceedingly rare. However, as the document was type-set, it can be assumed that a significant number may have been printed and distributed. The document qualifies as a valid place of publication for 17 new taxa (**Table 2**, column 1).

Table 2. Publication data of F.M.Bailey's Bellenden-Ker Expedition vascular plant taxa published as new (i.e. '*n. sp.*') in four publications. Listed are the page numbers for the protologue (**bold** type) and subsequent publication of the same taxon:

1: Bailey 1889a; 2: Bailey 1889b; 3: Bailey 1889c; 4: Bailey 1890a.

Bailey's taxon name	Currently accepted name for taxon (Bostock & Holland 2007)	Publication and page numbers			
		1	2	3	4
Alsophila rebeccae var. *commutata* F.M.Bailey	*Cyathea baileyana* (Domin) Domin [Cyatheaceae]	-	-	-	**91**
Aspidium acuminatum var. *villosum* F.M.Bailey	*Lastreopsis microsora* (Endl.) Tindale subsp. *microsora* [Dryopteridaceae]	-	**29**	78	93
Aspidium ramosum var. *lineare* F.M.Bailey	*Arthropteris palisotii* (Desv.) Alston [Nephrolepidaceae]	-	**28**	78	93
Bacularia palmeriana F.M.Bailey	*Linospadix palmerianus* (F.M.Bailey) Burret [Arecaceae]	-	**24**	67	77
Bambusa moreheadiana F.M.Bailey	*Mullerochloa moreheadiana* (F.M.Bailey) K.M.Wong [Poaceae]	**1**	26	71	87
Blechnum whelanii F.M.Bailey	*Blechnum whelanii* F.M.Bailey [Blechnaceae]	**1**	28	77	92
Bulbophyllum toressae F.M.Bailey	*Dendrobium toressae* (F.M.Bailey) Dockrill [Orchidaceae]	**1**	23	63	72
Citrus inodora F.M.Bailey	*Citrus inodora* F.M.Bailey [Rutaceae]	**1**	15	34	12
Cyanocarpus F.M.Bailey	*Helicia* Lour. [Proteaceae]	**1**	21	55	60
Cyanocarpus nortoniana F.M.Bailey	*Helicia nortoniana* (F.M.Bailey) F.M.Bailey [Proteaceae]	**2**	21	55	61
Cyrtandra baileyi F.Muell.	*Cyrtandra baileyi* F.Muell. [Gesneriaceae]	-	-	-	**51**
Denhamia viridissima F.M.Bailey & F.Muell. ex F.M.Bailey	*Denhamia viridissima* F.M.Bailey & F.Muell. ex F.M.Bailey [Celastraceae]	-	-	**35**	14
Derris koolgibberah F.M.Bailey	*Derris koolgibberah* F.M.Bailey [Fabaceae]	-	**16**	38	20
Dimeria glabriuscula F.M.Bailey	*Dimeria ornithopoda* Trin. [Poaceae]	-	-	-	**83**

Bailey's taxon name	Currently accepted name for taxon (Bostock & Holland 2007)	Publication and page numbers			
		1	2	3	4
Ficus crassipes F.M.Bailey	*Ficus crassipes* F.M.Bailey [Moraceae]	**2**	22	60	69
Garcinia mestonii F.M.Bailey	*Garcinia mestonii* F.M.Bailey [Clusiaceae]	**2**	14	31	8
Harpullia frutescens F.M.Bailey	*Harpullia frutescens* F.M.Bailey [Sapindaceae]	-	**15**	36	17
Helicia whelanii F.M.Bailey	*Macadamia whelanii* (F.M.Bailey) F.M.Bailey [Proteaceae]	**2**	21	55	61
Hymenophyllum trichomanoides F.M.Bailey	*Hymenophyllum baileyanum* Domin [Hymenophyllaceae]	-	**27**	74	90
Hymenophyllum tunbridgense var. *exsertum* F.M.Bailey	*Hymenophyllum subdimidiatum* Rosenst. [Hymenophyllaceae]	-	**27**	74	90
Hyptiandra bidwillii var. *grandiuscula* F.M.Bailey & F.Muell. ex F.M.Bailey	*Quassia baileyana* (Oliv.) Noot. [Simaroubaceae]	-	-	-	**12**
Leptospermum wooroonooran F.M.Bailey	*Leptospermum wooroonooran* F.M.Bailey [Myrtaceae]	-	**17**	40	27
Melicope chooreechillum F.M.Bailey	*Acronychia chooreechillum* (F.M.Bailey) C.T.White [Rutaceae]	-	**15**	33	11
Myrtus metrosideros F.M.Bailey	*Uromyrtus metrosideros* (F.M.Bailey) A.J.Scott [Myrtaceae]	-	17	41	**27**
Oberonia pusilla F.M.Bailey	*Octarrhena pusilla* (F.M.Bailey) M.A.Clem. & D.L.Jones [Orchidaceae]	**2**	23	62	71
Omphalea queenslandiae F.M.Bailey	*Omphalea queenslandiae* F.M.Bailey [Euphorbiaceae]	-	-	**58**	67
Orites fragrans F.M.Bailey	*Orites fragrans* F.M.Bailey[1] [Proteaceae]	**2**	21	56	61
Panicum prenticeanum F.M.Bailey	*Panicum incomtum* Trin. [Poaceae]	-	-	-	**82**
Panicum vicinum F.M.Bailey	*Ichnanthus pallens* var. *major* (Nees) Stieber [Poaceae]	-	-	-	**82**
Piper mestonii F.M.Bailey	*Piper mestonii* F.M.Bailey [Piperaceae]	**2**	20	54	59

Bailey's taxon name	Currently accepted name for taxon (Bostock & Holland 2007)	Publication and page numbers			
		1	2	3	4
Polypodium albosetosum F.M.Bailey	*Grammitis albosetosa* (F.M.Bailey) Parris [Grammitidaceae]	**3**	29	78	94
Scaevola scandens F.M.Bailey	*Scaevola enantophylla* F.Muell. [Goodeniaceae]	**3**	18	47	43
Scleria ustulata F.M.Bailey	*Exocarya scleroides* (F.Muell.) Benth. [Cyperaceae]	-	-	-	**81**
Sorghum laxiflorum F.M.Bailey	*Vacoparis laxiflorum* (F.M.Bailey) Spangler [Poaceae]	-	**25**	70	84
Strychnos bancroftiana F.M.Bailey	*Strychnos minor* Dennst. [Loganiaceae]	**3**	19	49	47
Symplocos paucistaminea F.Muell. & F.M.Bailey	*Symplocos paucistaminea* F.Muell. & F.M.Bailey [Symplocaceae]	-	-	-	**46**
Trichomanes barnardianum F.M.Bailey	*Crepidomanes barnardianum* (F.M.Bailey) Tindale subsp. *barnardianum* [Hymenophyllaceae]	-	-	-	**89**
Vallisneria gracilis F.M.Bailey	*Vallisneria nana* R.Br. [Hydrocharitaceae]	**3**	23	62	70
Vittaria (*Taeniopsis*) *wooroonooran* F.M.Bailey	*Scleroglossum wooroonooran* (F.M.Bailey) C.Chr. [Grammitidaceae]	**3**	27	75	92

[1]reinstated to species rank at BRI (P.I.Forster, pers. comm., August 2007)

2. '*Report by A. Meston on the Government Scientific Expedition to the Bellenden-Ker Range (Wooroonooran), North Queensland*'. This is a foolscap-sized Parliamentary Paper in *Queensland: Votes and Proceedings of the Legislative Assembly during the Session of 1889*. The botany section was titled '*Botany of the Bellenden-Ker Expedition, by Fredk. Manson Bailey, Colonial Botanist*' and covered pp. 14–29 of the Parliamentary Paper, and repaginated and over-printed as pp. 1218–1233 in Volume 4 of a compilation of Parliamentary Papers for that year. This paper was tabled in the Queensland Parliament on 16 October 1889 (R. Bradbury, Queensland Parliamentary Service, pers. comm.).

In this version, Bailey annotated a total of 583 taxa, of which one genus and 23 species were annotated as '*n. sp.*', and three as new varieties (N.B: Bailey did not designate these as new but simply applied a new varietal name to an existing species), and including the 17 species previously described in '*Report on New Plants*' (see above). All taxa were listed according to the classification of Bentham and Hooker (1862–1883), with species name, author, common name, description and collection location. Bailey provided expanded descriptions of some established taxa. The descriptions of the 17 redescribed '*n. sp.*' taxa were identical to those in '*Report on New Plants*'. This publication therefore has

the protologues of an additional ten taxa that were therein validly published (**Table 2**, column 2).

3. '*Report of the Government Scientific Expedition to Bellenden-Ker Range upon the Flora and Fauna of that Part of the Colony*'. This was published in octavo-size by the Department of Agriculture, Brisbane. The botany section was titled '*Botany of the Bellenden-Ker Expedition*', covering pp. 29–80. The introductory section by Archibald Meston was identical to that included in the Parliamentary Paper version, and following the botany section there was an additional section on the Zoology of Bellenden-Ker Ranges by Henry Tyron and Charles Hedley, thus bringing the total number of pages in the document to 127.

The title page is dated 1889, and there is strong circumstantial evidence that this version was published after October 1889. Apart from including additional taxa, there is a footnote (p. 35) in which Bailey noted that F.Mueller (Victorian Government Botanist) had seen some specimens and provided assistance with descriptions: "*The few plants marked with an asterisk I obtained but poor specimens of, but Baron Mueller has kindly assisted me in their determination. The descriptions in all cases, however, are my own*". As Bailey did not return to Brisbane until early September, it may be that dispatch of specimens to Mueller and for Mueller to respond would have taken longer than the maximum of five weeks before the Parliamentary Paper version (see above) was tabled on 16 October 1889. Bailey's introductory paragraphs are dated even earlier, at 7 October 1889, but this may not be related to the botanical assessment as an identical letter, also dated 7 October 1889, was used in the preamble to the Parliamentary Paper version.

This version was more expansive in layout, with headings by class, order and genus, with full taxonomic citation, and some additional notes. There were seven additional taxa, bringing the total to 590 taxa, of which two were new taxa that had not been included in either '*Report on New Plants*' or the Parliamentary Paper version (**Table 2**, column 3).

4. '*Synopsis of the Queensland Flora, Third Supplement*'. This was published post May 1890, and all of the new taxa that were published in the preceding publications (see above) were again designated as '*n. sp.*' in this publication, but needless to say do not qualify as valid protologues. However, there were an additional eight new taxa described from the Bellenden-Ker Expedition collections, and these had not been previously described (**Table 2**, column 4).

There were also other new taxa subsequently described from the Expedition by Bailey, but these did not appear in print until the early 1890s and later, in publications such as *Botany Bulletin*, *Queensland Agricultural Journal*, *Queensland Flora* and *Comprehensive Catalogue of Queensland Plants*, and all of which were published as '*n. sp.*', and in most cases, to our knowledge, only once. However, Bailey did produce some other lists of species, some of them designated as '*n. sp.*' in various appendices to Department of Agriculture Annual Reports. For example, in the Annual Report of 1889–1890 in an appendix titled '*Supplement to the report of the botany of the Bellenden-Ker Expedition*', Bailey listed nine taxa that had been described in *Synopsis of the Queensland Flora, Third Supplement*, but he appended these with the appropriate authorship. In the Annual Report for 1890–1891, in a section that was titled '*Final supplement to the report of the Botany of the Bellenden-Ker Expedition*', Bailey listed nine higher plant species of which five were appended as '*n. sp.*'. However, there was no description accompanying these names and taxonomically they can be relegated to the status of *nomen nudum* if deemed to be published before the valid protologues in various issues of *Botany Bulletin* for 1891.

Discussion

White (1950, p.109) appears to be the first to comment on the discrepancies concerning publication priority involving the two versions of Bailey's Bellenden-Ker Expedition botany reports. White described the Parliamentary Paper version as "*extremely rare, however, even in Australian libraries*", whereas the Department of Agriculture version "*was the*

one always quoted by Bailey himself and by subsequent authors". White concluded that the Parliamentary Paper version had priority. However, both of these were preceded by the '*Report on New Plants*' dated 1 October 1889, in which 17 new taxa were validly described. These taxa were in turn 're-described' in the Parliamentary Paper version of the botany report, and which was tabled 16 October 1889, with a number of additional previously undescribed taxa. Subsequently, these taxa were 'redescribed' in the Department of Agriculture publication post-October 1889 and again in post-May 1890 in Bailey's '*Synopsis of the Queensland Flora, Third Supplement*'.

The chronology of those publications in which Bailey's Bellenden-Ker taxa were described and then redescribed, though nomenclaturally illegal, as '*n. sp.*', has been clearly established in this paper. All species that were described in the various publications herein discussed, are listed in **Table 1**. It is anticipated that this assessment of Bailey's Bellenden-Ker botany will resolve some of the inconsistencies in taxonomic citations for the taxa involved.

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Trioncinia patens A.E.Holland & D.W.Butler (Asteraceae: *Coreopsideae*: *Chrysanthellinae*), a new and endangered species from central Queensland

A.E.Holland & D.W.Butler

Summary

Holland, A.E. & Butler, D.W. (2007). *Trioncinia patens* A.E.Holland & D.W.Butler (Asteraceae: *Coreopsideae*: *Chrysanthellinae*), a new and endangered species from central Queensland. Austrobaileya 7(3): 567–571. The new species *Trioncinia patens* is described and illustrated, together with a map of its distribution. A table is provided listing the characteristic differences between the two species of the genus, *T. patens* and *T. retroflexa*. The distribution, habitat and conservation status of *T. patens* is discussed. It is only known from three locations in and near the Peak Range National Park between Clermont and Dysart in Central Queensland where it occurs in eucalypt woodland or grassland. A conservation status of Endangered is recommended.

Key Words: Asteraceae, *Coreopsideae*, *Chrysanthellinae*, *Trioncinia patens*, *Trioncinia retroflexa*, new species, Australia, Australian flora, Queensland flora, central Queensland, Peak Range National Park, endangered species

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Introduction

Mueller (1858) first described *Glossogyne* Sect. *Trioncinia* F.Muell. based on *Glossogyne retroflexa* F.Muell. For many years this species was known only from a single specimen collected by Ferdinand Mueller at Peak Downs in 1856. Veldkamp raised the section to generic rank and made the combination *Trioncinia retroflexa* (F.Muell.) Veldkamp (Veldkamp & Kreffer 1991). *Trioncinia retroflexa* was rediscovered during intensive survey work in 1997 (Fensham 1999) and eight populations of this endangered species are now recorded. The genus *Trioncinia* (F.Muell.) Veldkamp is distinguished from other members of the subtribe *Chrysanthellinae* Ryding & K.Bremer by the cypselas which have 3 or 4 awns (Panero 2007).

The new species described here was discovered during survey work in the Dysart area, when a strange looking cypsela was found in the sock of the second author. Six individuals of this species were subsequently located growing alongside *Glossocardia bidens* (Retz.) Veldkamp and required close examination to distinguish them. This new species is currently known from only three locations in the Dysart area.

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Taxonomy

Trioncinia patens A.E.Holland & D.W.Butler, species nova a *T. retroflexa* (F.Muell.) Veldkamp cypselis minoribus (5–7 mm longis) costis transversis tenuibus ornatis, costis longitudinalibus deficientibus, aristis subaequalibus quatuor apice instructis, praecipue distinguenda; et quoque planta parva floribus radii cypselis foliisque minoribus vulgo praedita. **Typus**: Queensland. LEICHHARDT DISTRICT: Eastern Peak, 30 km W of Dysart, 8 February 2006, *D.Butler 122 & J.Ambrose* (holo: BRI).

Perennial with a thick woody taproot and several stems arising from the caudex; all parts of the plant glabrous. Stems erect, to 50 cm high, branched mainly in the upper half. Leaves mostly basal, alternate, to 7 cm long, stem leaves smaller; petioles to 4 cm long; lamina pinnatifid, sometimes further divided, up to 3 cm long and 2 cm wide; leaf segments narrow, 1–1.5 mm wide, apiculate at apex, 1-nerved. Inflorescences branched in upper half of plant, peduncles 4–12 cm long, often with 1 or 2 bracts in the upper half. Capitula 6–9 mm diameter (to 15 mm diameter in

fruit), radiate; receptacle domed, 1.6–2.4 mm diameter. Involucres hemispheric, phyllaries in 2 or 3 series; outer phyllaries few, short triangular, 1–2 mm long, 0.5–1 mm wide; middle and inner phyllaries ovate to oblong or obovate, 2.4–3.6 mm long, 0.8–1.1 mm wide, 5-veined, with a scarious margin, surface green, often glandular. Receptacular bracts linear to lanceolate, 3–4 mm long, 0.1–0.3 mm wide. Ray florets female, 5, bilobed; claw 1 mm long; lamina obovate, 1.8–2.2 mm long, 1–1.4 mm wide, bilobed at apex, yellow; 5- or 7-veined, dark brown or red. Style of ray florets 2 mm long, style arms reduced, not extended beyond the stigmatic surface. Disc florets 11–17, hermaphrodite, 2–2.5 mm long, *c.* 0.2 mm wide, dilated in upper two-thirds, with 4 or 5 triangular lobes, 2 or 3 lobes have marginal veins only, the remaining 1 or 2 also have a mid-vein; all veins joining at the apex. Anthers *c.* 0.8 mm long, without tails, anther appendix obtuse, resinous. Style of disc florets *c.* 2 mm long, style arms *c.* 1 mm long, stigmatic surface one third the length of the arms. Cypselas terete, slightly wider in the middle, slightly curved inwards at apex, 5–7 mm long, 0.7–1.0 mm diameter (the outer ones slightly shorter), surface glabrous, lacking longitudinal ribs, with thin transverse ridges, smooth between ridges, pale brown, apex with 4 awns; awns spreading more or less at right angles to each other and to the body of the cypsela, 1–2 mm long, more or less equal in length or rarely one much shorter, retrorsely barbed, orange-brown. **Fig.1.**

***Additional specimens examined*: Queensland**. Leichhardt District: East base of Browns Peak, 30 km W of Dysart, Feb 2006, *Butler 123 & Ambrose* (BRI). South Kennedy District: Western base of Mt Castor, Peak Range National Park, *c.* 40 km NE of Clermont, Jan 2001, *Butler s.n.* (BRI [AQ669884]).

***Distribution and habitat*:** *Trioncinia patens* is known from only three locations, all on the toe-slopes of peaks in and near the Peak Range National Park between Clermont and Dysart in central Queensland (**Map 1**). It occurs in eucalypt woodland (*Eucalyptus orgadophila, E. crebra, E. melanophloia* and *Corymbia erythrophloia*), on basalt-derived dark-grey to red-brown clays or clay-loams, often with some surface gravel (Regional Ecosystem 11.8.4 or 11.8.5, (Environmental Protection Agency 2007).

***Notes*:** *Trioncinia patens* superficially resembles *T. retroflexa*, but is generally a smaller plant, with smaller ray florets, cypselas and leaves. *Trioncinia patens* is most reliably distinguished by the four spreading awns of the cypsela. *Trioncinia retroflexa* usually has three awns, rarely a small fourth one, and these are always reflexed when mature. The mature cypselas of *T. patens* are transversely ridged with thin ribs that are smooth between the ridges whereas the mature cypselas of *T. retroflexa* are longitudinally ribbed with thick transverse ridges becoming rugose or warty with age (**Table 1**).

Table 1: Characteristics of *Trioncinia* species

Character	*T. patens*	*T. retroflexa*
basal leaf length	3–7 cm long	4.5–17 cm long
width of leaf segments	1–1.5 cm wide	1–3.5 cm wide
ray lamina length × width	1.8–2.2 × 1–1.4 mm	3–3.7 × 2–2.5 mm
cypsela length	5–7 mm	8–11 mm
cypsela width	0.7–1 mm	1–1.3 mm
cypsela ridges	longitudinal ribs absent; transverse ridges thin, not overlapping, and smooth between ridges	longitudinally ribbed with warty transverse ridges becoming thickened or rugose with age
cypsela awns	4, spreading, subequal	3, strongly reflexed (rarely with a small fourth one)

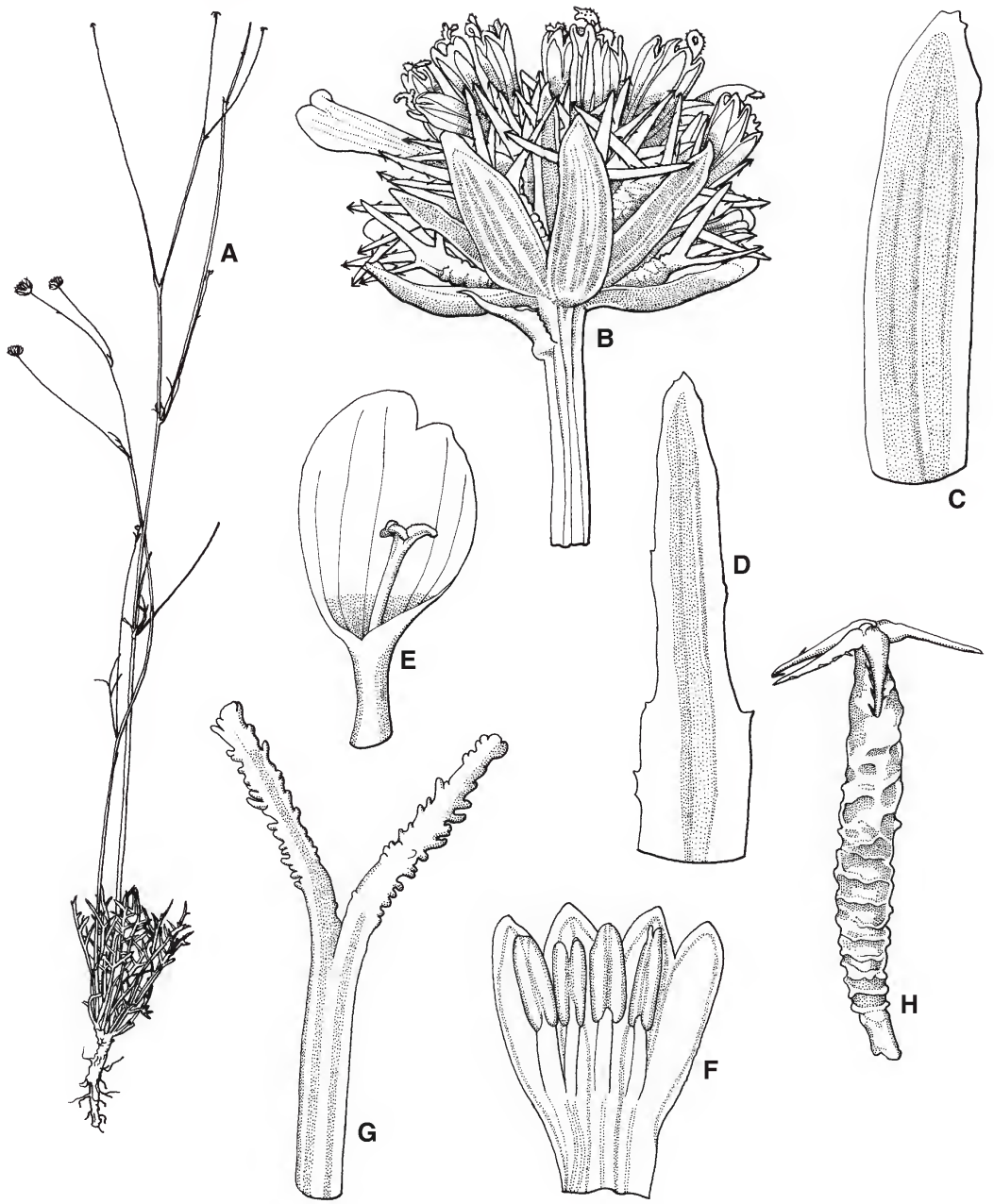

Fig. 1. ***Trioncinia patens***. A. habit × 0.3. B. capitulum × 8. C. phyllary × 16. D. receptacular bract × 16. E. ray floret × 16. F. disc floret with anthers × 16. G. style from disc floret × 32. H. cypsela × 8. A–G from *Butler 122 & Ambrose* (BRI); H from *Butler s.n.* (BRI [AQ669884]). Del. W.Smith.

The two *Trioncinia* species differ considerably in their habitat preferences. *Trioncinia retroflexa* occurs mainly in grasslands on rolling plains of heavy black clay, whereas *T. patens* occurs mainly in eucalypt woodland on the lower slopes of basalt or trachyte hills where soils are considerably lighter in texture and colour.

Some populations of *T. retroflexa* occur near woodland boundaries in grassland/woodland mosaics on higher parts of rolling basaltic plains, and one population of *T. patens* occurs in a small grassland on quite dark clay soil. However, this grassland is unlike any known *T. retroflexa* habitat. It is a patch slightly larger than 0.5 hectare, surrounded by eucalypt woodland and perched atop a broad ridge running off one of the Gemini Peaks.

***Conservation status*:** *Trioncinia patens* was found to occur in only three locations after considerable survey effort in the area. The northernmost population occurs in the Gemini section of Peak Range National Park (at the base of Mount Castor) and consists of only six individuals; the southernmost population at the base of Eastern Peak (also part of Peak Range National Park) has more than 100 individuals; the nearby population at the base of Browns Peak consists of less than 100 individuals and is not conserved. Under the IUCN criteria (IUCN 2001), *T. patens* can be categorised as "Endangered" under criterion D (population size estimated to number fewer than 250 individuals). Threats to current populations are assumed to be similar to those of *T. retroflexa*, including grazing, weed infestation and inappropriate fire regimes, although *T. retroflexa* is tolerant of spasmodic disturbance (Fensham *et al.* 2002). Monitoring of the three populations in the area is recommended.

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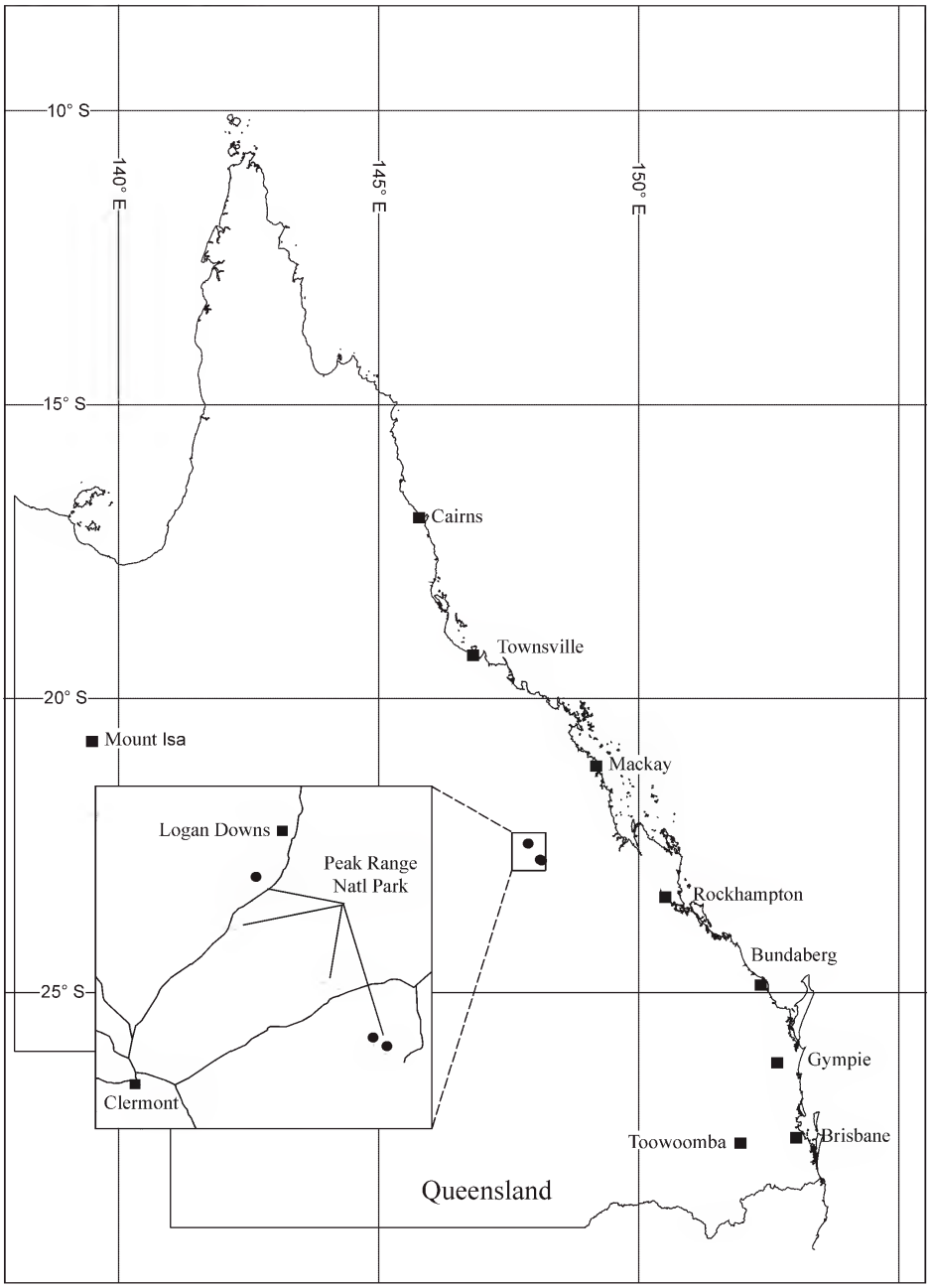

Map 1. Distribution of *Trioncinia patens* ● .

SHORT COMMUNICATION

The distribution, habitat and conservation status of *Suregada glomerulata* (Blume) Baill. (Euphorbiaceae) from north-eastern Cape York Peninsula, Queensland

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A systematic survey of the rainforest vegetation of Cape York Peninsula, far north-eastern Australia, was carried out between 1992 and 1995 (Stanton & Fell 2005). The survey which provided site data utilised in the mapping of the region's vegetation (*cf.* Neldner & Clarkson 1995), described the variety of rainforest communities throughout Cape York Peninsula, and resulted in significant contributions of voucher specimens to the Queensland Herbarium (BRI) and other Australian herbaria. These records included a number of range extensions, including the first records of *Suregada glomerulata* (Blume) Baill. (Euphorbiaceae) for Queensland.

Suregada Roxb. ex Rottl. comprises 31 species of shrubs and small trees that predominantly occur in the tropical Asian – Pacific region, as well as Taiwan, South Africa and Madagascar (Govaerts 2004). The genus is characterised by leaves with unusual, secretory lacunae that may be adaptive for xeric environments (Wurdack *et al.* 2005).

Suregada glomerulata is a dioecious shrub or small tree with elliptic or narrowly cuneate-obovate leaves up to 18 by 6 cm (Airy-Shaw 1980). Leaves are typically decurrent at the base merging into a very short petiole with an obtuse or rounded apex and translucent areoles between the ultimate nerves (Airy-Shaw 1980). The stem blaze is reported as yellow (J.P. Stanton, pers. comm., June 2007). The flowers have been variously recorded as green (*Brass 8219*), greenish-cream (*De Wild 19353*), brownish yellow (*Woerjantoro 120*), and white (*Van Steenis 9884*, *Tangkilisan 93*, *Stanton 67*). Fruits are orange-red capsules and dehisce septicidally to present black seeds (EPA 2007).

Distribution – Non-Queensland habitat: *Suregada glomerulata* is widespread in western and eastern Malesia including Malaysia, Philippines, Indonesia, Timor and New Guinea (EPA 2007). Within these areas it inhabits lowland and lower montane rainforest between altitudes of 130 to 1160 m, often near running fresh water on a variety of substrates including limestone (Airy Shaw 1975 cited in RBGK n.d.; EPA 2007). It also occurs throughout southern China, in Hainan, Guangdong, Guangxi and Yunnan Provinces where it is common in open areas, roadsides, and early recovery vegetation such as 5–25-year-old secondary forests on abandoned lands of shifting cultivation (Ding & Zang 2005; Yi Ding, pers. comm., November 2006).

In the Northern Territory, *S. glomerulata* is known from vineforests and vinethickets on dry sandstone, sandy alluvium associated with springs, or lateritic substrates (Liddle *et al.* 1994; EPA 2007). The majority of the herbarium records are located in the Arnhem Plateau Bioregion, over an approximate extent of 100 km east-west by 140 km north-south (DPI 2006; Liddle *et al.* 1994; EPA 2007). The main population occurs in an area with an average annual maximum temperature of 34° C and average annual rainfall of 1200–1600 mm (DPI 2006). A disjunct population occurs in the Tiwi – Coburg Bioregion on Croker Island, some 200 km northwest of the main population (EPA 2007). In contrast to the predominately sandstone environments of the Arnhem Plateau Bioregion, the Croker Island population occurs on laterite in a maritime environment.

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Queensland Habitat: *Suregada glomerulata* was first collected in Queensland in the Iron Range area in March 1994 (*Fell & Stanton DGF4154*, Site 117 West Claudie River, Cape York Peninsula; Stanton & Fell 2005). The second collection in Queensland (*Stanton 67*, October 1995) was recorded within two kilometres of the first site. Both localities occur within Iron Range National Park within the traditional lands of the Kuuku y'au people (Horton 1994).

The initial Queensland collection of *Suregada glomerulata* was from semi-deciduous mesophyll-notophyll vine forest with *Acacia* species (Stanton & Fell 2005 – Type 49) where it was an uncommon understorey shrub up to 2 m in height. The survey site (Site 117) occurred on podzolic soils of poor internal drainage that are found on the lower slopes and adjacent colluvial deposits of granite ranges (Stanton & Fell 2005). Granite boulders outcrop on the site amongst which *Dendrocnide cordata* was frequent. The well-developed but uneven canopy reaching 35 m in height was dominated by *Acacia polystachya*, *Terminalia sericocarpa* and *Canarium australianum*, and also featured *Brachychiton velutinosus* (listed as Rare in the *Queensland Nature Conservation Act (Wildlife) Regulation 2006* (*NCR 2006*)) and *Margaritaria indica* (listed as Vulnerable in the *NCR 2006*). The diverse understorey featured dense patches of the native bamboo *Neololeba atra* (listed as Rare in the *NCR 2006*). At the time of survey, the site was undisturbed by human activity and free of weeds.

The second collection of *Suregada glomerulata* was located in tall simple mesophyll/notophyll vine forest on a gentle slope, with red loam soils derived from weathered schist (Stanton & Fell 2005 – Type 38).

***Environmental Relationships*:** In contrast to the Northern Territory populations, the Queensland habitats of *S. glomerulata* are very wet (rainfall + 2,000 mm per annum), perhaps more resembling those described for the extra-Australian populations in Asia and Malesia. While the granitic derived soils present at the West Claudie River site are likely to exhibit acidic properties similar to those of soils derived from sandstones in the Northern Territory sites, the precise habitat parameters and relationships for this species are at this point speculative. Rainforest structure remains relatively constant in the West Claudie River area in response to geology; however, floristics vary considerably in response to soil properties, slope position and drainage (Stanton & Fell 2005). An exception is vegetation on the upper granitic slopes and ridges which support simpler evergreen notophyll forests, representative of a continuum between sclerophyll forest (*Acacia* dominated) and vineforest.

Conservation Status: *Suregada glomerulata* is widespread outside Australia and relatively well known in the Northern Territory where it is assigned "least concern" status under the *Territory Parks and Wildlife Conservation Act 2000*. In Queensland, the species is considered extremely rare, with two collections representing the only known occurrence of a highly disjunct population. On current information, the species is restricted to the West Claudie River catchment in the Cape York Peninsula bioregion in vegetation types that are restricted to the Iron Range area (Stanton & Fell 2005).

Based on available knowledge and the limited extent of known potential habitat, S. *glomerulata* may have a very restricted area of occupancy in Queensland. The species is conserved within Iron Range National Park and not currently under any apparent threat. Furthermore, the isolation of the population limits the potential incidence and degree of anthropogenic threats. However, there remains a risk of stochastic extinction of the species in Queensland due to its small population size and very localised extent of occurrence.

Accordingly, the species should be considered regionally significant in the Cape York Peninsula bioregion and afforded **Vulnerable** status under the *Nature Conservation (Wildlife) Regulation 2006* as consistent with Criterion D2 (IUCN 2001). This recommendation acknowledges the difficulties in attributing conservation status

to taxa which are rare in Queensland, both in terms of restricted geographic distribution and habitat, but widespread in neighbouring regions, for example Papua New Guinea where we have limited knowledge of their status. Such species in the Cape York Peninsula bioregion are numerous and include *Aglaia argentea*, *Aglaia brassii*, *Albizia retusa* subsp. *retusa*, *Brachychiton velutinosus*, *Cleistanthus myrianthus*, *Macaranga polyadenia*, *Margaritaria indica*, *Pimeleodendron amboinicum*, *Syzygium malaccense* and *S. buettnerianum*, all of which are currently listed as Rare (*NCR 2006*). In many cases, data on Australian and extra-Australian habitat of such species are limited and reliant on historical herbarium collections. While the broader distribution needs to be taken into account when considering the conservation status and potential for extinction of taxa that also occur outside Australia, there remains an obligation to protect all species extant within the country and to protect the genetic diversity inherent in populations on the edge of a species' range.

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